

SMALL-POX

ITS DISSEMINATION AND PREVENTION

FRANCIS STEVENS, M.D.



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thanks F. Stevens*

SMALL-POX

ITS DISSEMINATION AND PREVENTION

THESIS FOR DEGREE OF DOCTOR OF MEDICINE

BY

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SMALL-POX

ITS DISSEMINATION AND PREVENTION

INTRODUCTION

MUCH discussion has taken place as to the date of the first appearance of small-pox, some writers asserting it to have been a well-recognized malady long before the Christian era. The great plague of Athens, described by Thucydides in the *History of the Peloponnesian War*, ii. 49, is considered by some to have been this disease. In the fourth epidemic of Hippocrates there is a description of a pestilence characterized by eruptions and fever, and there are other descriptions given by ancient writers of epidemics which more closely correspond in their symptoms to small-pox than to any other disease. Moore (*History of Small-pox*) quotes the letters of French missionaries in China, who state that small-pox was unknown in China, where it is styled venom from the mother's breast, till the year B. C. 1122, but in India it was said to have been prevalent at a much earlier date. Philo (Willan, *Antiquity of Small-pox*), who lived in the first century, describes an illness characterized by the eruption of blisters, at first scattered over the body, but which afterwards united one with the other,

i. e. became confluent, while other eastern writers of repute, who lived at this time, describe a disease which had as one of its cardinal symptoms the appearance of a pustular rash on the face and body, and, what is more characteristic of small-pox, a similar breaking out in the throat.

Paulet (*Hist. de la petite vérole*) gives the credit to Aëtius, a Greek physician of the fourth century, as having been the first to describe the disease, and makes a strong point of the silence on this subject of Pliny, Celsus, and other writers of an earlier date. Mead also quotes Jacob Reske as having stated that he saw at Leyden in an Arab MS. a statement that in the year 572 small-pox first appeared in Arabia.

Noldeke (Creighton) asserted that it was in the year 569 that this disease first appeared on this planet, it being carried through the agency of stones dropped on the earth by birds.

St. Gregory of Tours (*Hist. Francorum*, v. 34), in describing what he calls *Morbus dysentericus*, gives as its main features a high fever, accompanied by vomiting, severe pain over the kidneys, and headache; symptoms suspicious of small-pox, but without any mention of an eruption.

A little later Marius makes use of the term *variola* in connexion with an epidemic which proved exceedingly fatal in Italy and the adjoining countries.

St. Nicasius, Bishop of Rheims in the fifth century, is supposed to have suffered from this malady (*minutam variolam*), and a prayer for his intercession

was composed for the use of those affected by the disease.

Moore (*History of Small-pox*), however, questions the meaning of the word *variola* in these extracts. Indeed, he considers, from the context, that the disease referred to by these writers was the plague.

Payne quotes Gilbertus Anglicus as giving the derivation of the word *variola* from the variety of colour assumed by the spots in this disease.

The difficulty, therefore, of coming to a definite conclusion as to the true date arises from the confusion then existing between small-pox, plague, and other eruptive fevers, which are all classed together under the term *Loimoi*, and, according to Willan, this confusion was most frequent between this disease and measles. McCabe quotes Wilde as writing that in A. D. 675 'there was a leprosie called the pox (in Irish termed Bolgach).'

All writers, however, seem to agree in giving the credit of writing the first succinct account of the small-pox to Rhazes, an Arabian physician who died in the year 932.

John of Gaddesden mentions the disease in his *Rosa Anglia*, wherein he describes his treatment of the malady in the king's son. In view of the modern attempts at treating the disease by red light it is interesting to note his insistence on the value of red hangings round the bed of one sick with small-pox.

Creighton thinks that although the disease rose to considerable prominence in Elizabethan times, it was

not till the Stuart era that its prevalence became a matter of serious social import; and it was perhaps due to this cause that Mead and Sydenham devoted so much time to its study.

In all the olden writers the preventive treatment is hardly mentioned, the various remedies being solely beneficial to the one attacked. Paulet, for example, states that even up to the year 1757 practically no means had been taken for its prevention.

CHAPTER I

THE DISSEMINATION OF SMALL-POX

THIS disease, which is included in those whose notification is compulsory under a penalty of £2, has been described as one of the most infectious of all diseases, more so than either Typhus or Scarlet Fever; and, moreover, able to produce its effects after the briefest period of exposure to the poison (Power). Gull and Jenner both agree with this, the latter quoting cases in support of this view and refers to its power of striking at a distance (*S. P. Hosp. Com.*, 4329-5331). It may well be doubted whether this is always the case. The *Lancet* (1894, ii. 205) reports a labourer as having been sleeping in a van with thirty others, and no other cases having occurred.

Paget (*Soc. Med. Off.*, Feb. 18, 1887) mentions an instance of a labouring man actually suffering who went to a hiring-fair, afterwards going on to his home, where he infected an unvaccinated baby, but without any occurrence of a widespread epidemic.

Birdwood quotes a case (*Public Health*, 1889) where seven persons were attacked by small-pox, and isolation was carried out in one case only, the others going about their ordinary avocations, one of which was dressmaking, quite unchecked. No mention is

made of any subsequent epidemic prevalence in the vicinity.

Bate (*B. M. J.*, July 28, 1894) records an instance where a boy had been ill five weeks with small-pox and another girl ill in the house, no doctor having been called in, and no epidemic having resulted.

Littlejohn, in his report for the City of Edinburgh for 1902, mentions a canvasser living in a house with seven others, who had also attended the out-patient department at the Royal Infirmary with the rash fully out, without there having been any extension of the disease.

An experience related by Millard in Leicester was that of a woman who sat in the out-patient room of the Infirmary with perhaps 100 patients round her. The only person who contracted the disease was some one (vaccinated in infancy) who sat near her. In such a town there must have been many unvaccinated children and as such especially liable to attack yet who escaped the disease.

Chalmers (Glasgow, 1901) reports a case where there had been opportunities for continued and concentrated infection in a certain tenement, but only those on the same staircase were attacked.

In Camberwell, in 1895, a woman, recently confined, was supposed to be suffering from chicken-pox, but in the light of subsequent events she may without doubt be declared to have had small-pox. This was in a poor and crowded part of the parish, and the occasion being one in which a levée is being con-

stantly held, the chances of the spread of infection are enormous; yet only a few (eight cases in all) occurred, and these in the immediate vicinity. A decision as to relative infectivity of the disease is more difficult on account of the resisting influence of vaccination, which varies in each individual, but there is no particular reason to consider the neighbourhood as a well-vaccinated one.

The experience gained through the last big London epidemic confirms this theory of its being less infectious than has been usually supposed. When the patient, from some cause or other, had remained at home for periods varying from one day to a week or more after the appearance of the rash, in most instances it was among those in attendance and those who had been merely visiting the patient that succeeding cases were found; but that it was comparatively rare for either of the adjoining houses to be attacked unless the tenants were on friendly terms. Haygarth in the eighteenth century pointed out that the disease had not spread so much on account of contiguity as on the ground of intercommunication. Those who had visited the patient, even although they lived some distance away, were usually the ones to suffer, and if some one of a different family in the same house were attacked it was usually through an intermediate person contracting the disease who had been attending the patient.

Those who know the circumstances of the London house are aware that there is usually a certain amount

of intercommunication between two houses in the way of conversation, especially where there are only palings separating the two dwellings. If the disease then possessed this extreme infective power it is likely that we should have had many more instances of the adjoining houses being attacked.

That there is some factor in the spread of the disease which is almost as essential as the presence of the specific germ is obvious, for isolated attacks of small-pox occur constantly in every large centre but only occasionally are they subjected to outbreaks of epidemic proportions.

It has been supposed that a growing up of a population insufficiently protected gradually gives enough susceptible material to form the basis of an outbreak; and to certain meteorological conditions have been ascribed influences favouring the spread of the disease. As is now recognized epidemics of small-pox like those of scarlet fever vary much in their types, and it is possible that the presence of the mild type may lead to a greater number of unrecognized sufferers who spread the infection far and wide.

Support is given to such a theory by comparing the mortality rate of about five per cent., as it was in the years of exceptional prevalence in 1901-2, with 1894, a year not marked by any widespread epidemic, but one in which the mortality rate was about twenty-nine per cent.

The dissemination of the infection was formerly held to occur solely through the spreading abroad of

the particles from the dried crusts of the pustules that have matured and which are in process of disappearance, a theory which can hardly be correct, for it must of necessity preclude any infectivity in the pre-eruptive stage.

Makuna (*Epid. Soc.* April 5, 1882) brings forward ninety cases where careful inquiry had been made, and concludes, as a result of his observations, that the incubation period is non-infective.

Wynter Blyth (*Lancet*, 1894, ii. 586) agrees that there is not much danger in the pre-eruptive stage.

The opinion undoubtedly existed at the beginning of the 1901-2 epidemic in London among some sanitary officers that infectivity commenced at the time of reception of the poison into the system (i. e. ten to twelve days before the onset of the initial symptoms), for in several districts the exclusion for fourteen days from their respective occupations was required of all those persons who had been exposed to infection, although it was certain that their clothes had been adequately disinfected, and that in many cases they had been vaccinated or re-vaccinated as the case might be. The so-called Leicester system includes this quarantine for fourteen days as one of its regulations. The necessity for this isolation does not appear to be borne out by facts, for if it were we ought to have epidemics of far greater severity, since all persons incubating small-pox usually go about their ordinary avocations and should of necessity spread infection far and wide. Take, for example, a child

who contracts small-pox, and who, during the incubation period, has been attending school in a class of forty to fifty children, and in intimate contact with them all this time. If he were infectious throughout this period surely nothing could save the school from an epidemic even if it were only unprotected to the normal London standard of twenty per cent. ; yet such outbreaks are uncommon, the usual course of events being that extension occurs through the attendance at school of a child in whom small-pox has only been diagnosed on the appearance of the rash.

In the case also of tramps whose perambulations during the incubation period have been carefully traced, if the theory of infectivity during this stage be correct, should they not have left a trail of small-pox behind them at each place they have sojourned in the same way that they frequently do when they have been travelling with the disease well developed?

Authorities seem to be in accord that the disease is infective in the invasion stage, some even going so far as to maintain that its power for evil is as pronounced at this time as at any other (*Bull. des Hôp.*, iv. 32). Without committing oneself so far as this there is no reason to doubt its infectivity at this period. Wheatley (*Public Health*, vi. 384) found the number of secondary cases occurring in houses to show an increase corresponding to the length of time elapsing between the appearance of the disease and the removal. Niven's observations on the same subject would seem to show that more secondary cases arise

when removal is delayed to the fourth day. Yet it is possible that the greater liability to infection may arise from the longer exposure to the danger of such an event.

It is obvious that granting, as I think we must, that the disease is infectious during the pre-eruptive stage when there are no scabs, that the drying and scattering of the crusts is insufficient to account for the spread of the sickness. Dowson (*Public Health*, vi. 292) leans to the belief that the infective particles are exhaled with the expired air. This is difficult of explanation, as expired air is usually described as sterile, owing to the tendency of all organisms to cling to moist surfaces, although the air in expiration may in its passage across the face pick up some infective material.

In tuberculosis the bacilli have been shown to be disseminated by coughing, and there is no reason why a similar occurrence should not take place in variola, particularly when the throat is much involved.

Jenner supposes (5337) that the infection lasts until the disappearance of the scabs, and Moore agrees that isolation should be kept up until the last one has dropped off.

That the poison is tenacious of life can hardly be doubted. Brinkerhoff was able to produce a varicellous keratitis from the crusts from a small-pox patient which were eighty-five days old.

The aggregation of convalescent cases has not been followed by any special incidence of small-pox round a

hospital,—it is mentioned, for example, that there were no cases among the imbecile children at Dartford, who were within 300 yards of the small-pox convalescents (Q. 258), and even the supporters of aerial convection are disposed to limit this danger to the acute cases.

There can be little doubt but that the chief cause, so far as London is concerned, of the dissemination of small-pox is the perambulation of those who are suffering from the disease in a mild form. This indeed would appear to be the explanation of the fact so often referred to in reports of medical officers that the particular source of infection cannot be traced. Owing to the modification and mitigation of the characteristic symptoms by vaccination, a large number of cases remain unrecognized, for the reason that the sufferers do not feel sufficiently bad to seek medical advice, and, according to the customary lay ideas on infection of measuring the infectivity by the severity of the symptoms, they take no precautions. A butcher's salesman in Peckham, who had been ill for some days, as he was walking about Smithfield Market, was told by a friend that he looked as if he had small-pox. He travelled home to Peckham, called in a doctor, who ordered his immediate removal. The daily reports of the medical officers of health of the London boroughs and the observations made on recent epidemics in the country give constant instances of similar events. Instances are given in the Small-pox Hospital Commission (1820, &c.), and the Sheffield

outbreak of 1887-8 started in two unrecognized cases, one of which was supposed to be chicken-pox.

This spread of the disease by unrecognized cases was mentioned by Dr. Allen (*B. M. J.*, 1892, i. 1117), where two distinct outbreaks were traceable to this cause. (See also Thresh, *Lancet*, 1894, ii. 398.)

Chalmers also reports some characteristic examples of the evil effects of the mild cases. Wynter Blyth, too, mentions a man who travelled to England from Moscow while actually suffering from small-pox, thereby importing the disease into Stalybridge and other places (*Report*, May, 1900), while in another instance a soldier had travelled from Delhi to Egypt, where he walked into a doctor's consulting-room and asked for a diagnosis (*Lancet*, 1888, ii. 91).

During the last epidemic it was not an uncommon event upon visiting a house on the first notification to find another already convalescent person. The medical officer for health for Hull in his report for 1899 describes the case of a man taken ill on February 5, and who resumed work again until February 25, when he was discovered on account of his wife having contracted the disease. Millard and Boobyer have also recently pointed out some instructive occurrences in Leicester and Nottingham respectively.

The house in which unrecognized small-pox exists suffers frequently and severely, but it does not usually spread to those in the neighbourhood except to those who have been in contact.

The dissemination of the disease by contacts is

a subject of interest both from the point of view of causation as well as that of prevention. By contacts are meant those persons who, although they are themselves free from any sign of disease, have recently been in contact with sufferers. A certain number will be doubtless incubating the disease, and I have elsewhere given my opinions for regarding persons in this condition as not being a source of danger in themselves, but that the clothes they wore, especially if these had been brought in any way into close contact with those attacked, are likely to spread infection. Gull (Small-pox Hospital Commission) speaks of the liability for the poison to be carried in the clothes of those who have been visiting small-pox cases without themselves suffering from the disease. Several instances are mentioned by Reynolds (*B. M. J.*, 1892, i. 1117), in which he traced the spread as being due to visiting persons ill with small-pox. Mexborough and many other districts had similar experiences at that time.

During the last London epidemic there were many who went down to the hospital ships to see their friends who were inmates; to these re-vaccination was offered in all instances, but it was seldom taken advantage of, and all that the superintendents could do was to warn the various sanitary authorities that persons from their districts had been exposed to infection, so that daily inquiry could be made at the homes of such visitors. It is well that they lived at the present date, for in the year 846 the Normans,

when marching on Paris, were attacked by a severe pestilence to which numbers fell victims; the king, fearing that the contagion must reach him, beheaded all those who were themselves suffering from the sickness or who had been in contact with such sufferers.

The theory of the necessity of strictly isolating those who have been in contact with the patient on the ground that they may be considered a danger to the community has already been criticized and condemned. Nevertheless, it has been advocated apparently in all seriousness. Littlejohn (*Public Health*, vol. v), in a paper dealing with the prevention of small-pox, recommends that not only should the patient himself be isolated, but that all persons who have been in contact with him are themselves to be treated in like manner, thus freeing the neighbourhood from all sources of infection. A somewhat similar procedure was followed in Philadelphia, where negroes who had been in an infected hut in which ten lived were kept prisoners almost at the bayonet point (*Lancet*, 1903, i. 258). Such isolation of contacts is also mentioned by Priestley as one of the conditions which hindered the spread of the disease in Leicester; at Peterhead also (*Lancet*, 1901, ii. 174) a house was hired for the reception of contacts.

In 1901 the Local Government Board issued a memorandum which points out the absence of any need for quarantining those who have merely been in contact with sufferers but who themselves are free

from any signs, providing that their clothing has been disinfected and observation is kept on them. Experience and judgement alike seem to indicate this course as far preferable to quarantine, which is already discredited at our ports so far as other diseases are concerned, although it seems to have been practised in Australia as recently as 1901 (*Lancet*, 1901, ii. 253, 496). Apart altogether from the useless expenditure it entails, it becomes impracticable directly the epidemic reaches any magnitude. For instance, in one week during the last outbreak no less than 2,200 persons were under observation in Camberwell alone. Had we decided to quarantine these, strict isolation must have been provided, and, if so, where could it have been found? Or if, on the other hand, we had compelled them to remain at home, how could we have exercised a sufficient amount of supervision over them to ensure them obeying all our restrictions? This, however, is quite another matter to relaxing all supervision over those who are contacts. The names of all those who have been in contact, even in the very slightest degree, with the sufferer should be taken, although, as I have indicated above, it is those who have been in close and immediate association with him that are most disposed to be subsequently attacked; and to these the closest attention should be paid. The names of all those should be taken who are at work, whether in or outside the boundary of the particular sanitary district in point; if the latter, the respective outside authorities can be warned to

make the necessary daily inquiries as to the health of these contacts during the incubation period. So far as school children are concerned, it will often be found more convenient to get a list of the class of the patient and for the inspector to call daily at the school for sixteen days; if there are any absentees, prompt inquiry can be made about them at their homes. In the same way a list may be made of those who were most in contact with the patient at his work, and daily information sought as to the absentees from the factory or shop where he was employed.

The necessity of obtaining accurate information as to the address, &c., of contacts is urgent and obvious—in Liverpool, for instance, during the last epidemic, they were able to convict five persons under a local Act, which from the lack of being general rendered powerless the majority of other authorities in England, powerless even in cases where deliberate misstatements about the place of work were resorted to.

The length of time that contacts should be kept under observation can only be satisfactorily settled when we have decided as to the length of the incubation period.

In the *Bulletin des Hôspitaux*, vol. v, a case is reported in an infant where the incubation period appeared to have been no more than two days.

The duration of the incubation period is variously given from one to forty-six days (Guyot). Laboulbene (*L'incubation de la variole*, Soc. des Hôp., v. 214),

in the course of a debate on the matter, remarked, judging from several observed cases in which it was possible accurately to fix the date of infection, that it may vary from twelve to fifteen days. This opinion, although shared by the majority of those present, did not commend itself to all; at the same time it is the period which has been found to obtain in actual practice.

Among contacts must be considered those who have been visiting those suffering from the disease. This danger had been recognized so far back as the eighteenth century, and it has further been noticed that outbreaks have ceased to occur after visiting has been stopped. That more of such persons who are not re-vaccinated at the hospital do not contract small-pox is due probably to the shortness of the exposure, but it was not by any means an infrequent event among such visitors, and there is the additional danger that occasionally clothing is borrowed in order to go to the hospital 'decent,' thereby providing for a further spread of the infection.

Among the rarer means of convection of the disease, discharged patients have been supposed to convey it. A girl was taken away from Peckham to the Wharf supposed to be suffering from small-pox, although the history did not indicate this disease. After examination at the Wharf she was vaccinated and returned home as not having had small-pox, but twelve days after a case of this disease developed in the house, which was duly removed to the ships.

Occasionally, difficulty arises when a woman is attacked who has a child at the breast. The practice of the Metropolitan Asylums Board was to remove the latter to the ships, but recently a different procedure has been adopted, a child not being removed unless suffering from small-pox or unless there were special circumstances which necessitated its accompanying its mother.

In common with most of the other infectious diseases, the prevalence of small-pox exhibits a remarkable seasonal regularity, together with other periods of epidemic character which are apparently cyclic in nature. In the explanation of these variations many theories have been brought forward, none of them, however, being entirely convincing, and it is difficult to say whether there is a greater susceptibility to attack during the prevalence of certain meteorological conditions, or whether the conditions themselves favour the spread of infection. There is no *prima facie* reason why small-pox should have periods of greater seasonal prevalence, for it has been demonstrated that if this illness be introduced into a susceptible community and is allowed to go on unchecked it will prevail until it has burnt itself out, whether it be autumn or any other season.

Speaking generally, however, it is in winter and spring that small-pox is most usually met with in the epidemic form.

Rhazes speaks of the end of autumn and the begin-

ning of spring as being the season of greater prevalence, and also in putrid pestilential states of the air, while Morillon opines that it is the latter alone that is the more favourable period. Douglas, writing in the year 1730, considers that a close southerly wind renders persons more liable to receive the infection. Davison (*Trans. Epid. Society*, 1897) states that the recrudescence of the malady is universally associated with the first rapid fall of temperature after the summer heats, and he points out that the months of increased prevalence are different in the two hemispheres.

Dr. Alexander, of Poplar, from a study of the notifications and meteorological conditions which existed in London during the epidemic of 1901-2, concludes that the prevalence was favoured by the absence of sunshine, lowness of temperature below 50 degrees, and humidity above 75 per cent.

The spread of the disease has frequently, and with justification, been put down to vagrants. Paget (*Salford Epid.*, 1892-3) states that on seventeen separate occasions the disease was introduced into Salford by tramps.

Armstrong (*Public Health*, v. 305) says that after inquiry he found that in 59 per cent. the disease was introduced into urban districts (sixty-three in number) by tramps; and in Durham it is stated that the great majority of outbreaks have originated from introduction in this way.

The *Lancet* (1894, i. 352) quotes a report saying

that small-pox had been thirteen times introduced into Warrington by these individuals.

Dunlop (*Lancet*, 1894, ii. 71) gives his experience of having examined the casuals for seven months, during this time seeing 3,896 tramps, and three cases of small-pox; he states that several tramps did not even know what vaccination meant.

On account also of the possibility of the existence of the disease in a light form, they may infect many casual wards. An instance of this is mentioned (*Lancet*, Apr. 15, 1893) where the labour master at Oxford died from small-pox which he caught from a tramp. This man was not detained at Oxford, but at Thame, to which he was sufficiently well to be able to walk.

It is observed that certain occupations, such as disinfectors, who as the reports of the London Medical Officers of Health show during the 1901-2 epidemic, seem to have suffered rather severely. It has been alleged that postmen and policemen have been attacked more than others. There did not seem to be many instances reported of this; but that letters, &c., may convey the infection appears probable from the report of Karkeek (Torquay, 1894), who mentions the case of a young man engaged to a nurse employed at a small-pox hospital in another part of England, who contracted the disease although he had not been knowingly exposed to infection. A medical man in Dublin is also supposed to have contracted the disease from a letter he had received (*B. M. J.*, Oct. 24, 1891).

The case is also mentioned of the infection of two brothers who had received prize coupons from an infected district. Boobyer, in his report for 1901, describes an outbreak of small-pox of a mild type among members of a Mormon mission, who had not, as far as it was possible to ascertain, been in any place where small-pox was known to exist, but who had been in the habit of receiving parcels of papers and books from Salt Lake City, where the disease at that time was prevalent. Books also have been described as vehicles of contagion (*Public Health*, vi. 352). A book of a building society belonging to a person dead of small-pox was sold, and the buyer subsequently contracted the disease. Gayton also mentions instances (*Small-pox Hospital Commission*, 2656). A hotheaded anti-vaccinationist, who had just lost his wife and three children, is reported to have borrowed a suit of black from a neighbour who took small-pox a fortnight after it was sent back (4241). A century ago Haygarth mentions the danger of infected clothing. Complaint was made in Fulham that the patients gave the nurses postage stamps to be changed at the local post offices (5218), and this was supposed to have caused a spread of the disease.

In the Sheffield epidemic, Barry reports various cases as having occurred among the police (ten men out of 372), in consequence of their having been brought into connexion with infection (*Vacc. Com.*, 2028).

Reece states that in Liverpool there were several

isolated outbreaks due to the importation of the disease from Boston, U.S.A., by men who worked on the cattle boats; and there have been recently cases in London among passengers in a ship where small-pox had occurred.

It has also been suggested that the infection has at some time spread along the line of sewers, and Bristowe in his evidence (Q. 495 and 507) seems to think that cases more frequently occur along lines of drains than on lines of ambulance approaches. Farr (Q. 1900) agrees with Bristowe, and comments on the number of cooks and kitchen-maids attacked, who, he surmises, would be more liable to be in contact with drain effluvia. Mason of Hull states that the outbreak in an industrial school ship was possibly caused by the discharge of the sewage from the hospital at an outfall near the ship. Power's investigations do not bear out this theory so far as the Fulham outbreak is concerned; indeed, in the case of this hospital, the principal centres of infection did not lie in the direction of the drains; and Barry's experience at Sheffield bore out this statement. Bompas (Q. 346) quotes an experience of Dr. Richardson which would seem to imply that infection could be conveyed by an open drain. Tripe, however, speaking (2243) of a sewer built especially for the Metropolitan Asylums Board, says that the disease did not spread any more in its course than in other directions.

Richards (*Public Health*, 1893, p. 365) comments

on the number of flies surrounding a bad case of small-pox, and he suggests as one of the precautionary measures to be taken, the destruction of these insects as far as possible, while Scurfield suggests gauze to the windows. Priestley also mentions the possibility of flies conveying the disease. An epidemic in French North Africa was also ascribed to this cause, it being supposed that they would fly in the direction of the prevailing wind; and as they have played a part in the spread of granular conjunctivitis, there does not seem to be any reason why they should not act the same rôle in the case of small-pox.

The business of an undertaker, necessitating as it does close contact with the body, is not without danger, especially in the case of the burial of persons dying of the disease in an unrecognized form.

Priestley (*Public Health Engineer*, Feb. 1, 1902) mentions two of this trade as having contracted small-pox, in one infecting other members of the family; at Malden, in 1894, an undertaker and his assistant both contracted the disease, the latter in an unrecognized form.

One witness before the commission states that there is considerable incidence on charwomen and washerwomen (3229). Theoretically this is what we should expect, and especially those who are employed in laundries. In the last epidemic, however, there was no evidence that they were specially affected, in marked contrast in this respect to the disinfectors.

Niven (*Public Health*, v. 366) lays more stress on other conditions, e. g. dirt, darkness, and overcrowding, than drains. The main insanitary conditions which are of more general occurrence are defects in drainage, dampness, dirt, and overcrowding, and including under the latter the question of defects in ventilation.

Thorne, in his evidence before the Vaccination Commission, quotes Leicester as an instance from 1845-1861, that the small-pox death rate did not fall contemporaneously with an improvement in the drainage and water supply. Woodley, however, states that since 1872 sanitary improvements have been proceeding in Leicester contemporaneously with a neglect of vaccination. Rauch, from his experience in America, would agree that sanitation has nothing to do with the spread of small-pox.

Hutton speaks of small-pox as a disease especially deadly in the slums, and this no doubt it is; but it is accounted for by the neglect of vaccination, by overcrowding, the free intermixing of the people, and the great likelihood of a mild case passing unnoticed.

Barry mentions that the private drainage arrangements were most out of order in the better class houses, i. e. those with baths, and it is obvious that they are more dangerous than nuisances out of doors.

Preston (V.C. 3253), while expressing the opinion that from 1861 the mortality from small-pox has decreased, says there was a steady number of scarlet fever, mumps, and measles cases all that time.

Campbell (*Public Health*, ix), in discussing the Gloucester epidemic, refers to the statement that it was due to the insanitary state of the town. He points out that the parts to be attacked were the newest and least densely populated part of the city, and that bad drainage, bad arrangement of houses and density of population were to be found in the districts that had escaped small-pox.

The death rates from the zymotic diseases in Gloucester were:—

1893	. . .	2.17 per 1000.
1894	. . .	1.29 per 1000.
1895	. . .	1.65 per 1000.

The special commissioner of the *Lancet* in an article (*Lancet*, 1901, ii. 566) confirms these statements.

In Warrington in 1773 there were 211 deaths from this disease, all under ten years of age, while in 1892 there were fifty-five deaths, and of these forty-two were over ten.

The general death rate has, it is true, largely decreased; taking Warrington for example, in 1773 it was 59.1 per 1000 while in 1892 it had fallen to 23.0. Now in both these years there were epidemics of small-pox, and the death-rate from this disease in the former was 26.3, while in the latter it was 1.4 (all per thousand), instead of 10.2 which it would have been if the previous relation of the small-pox rate to the general had been maintained (Gornall, *Report*, 1893).

Not only this, if the great diminution of the small-pox mortality were due to general conditions we

should expect to find a corresponding diminution in the other diseases to which children are liable, viz. measles, whooping-cough, scarlet fever, &c., which has not taken place; moreover, the theory does not explain why the disease has now come to attack adults rather than children.

Cory, as regards measles quotes Manchester, where a hundred years ago the deaths from this disease bore the same relation to the general death rate as they do now. Warner (*Practitioner*, lxxiii. 499), in describing the Leicester epidemic, states that several of the mildest cases occurred among the dirtiest and most insanitary conditions. Higher social standing did not appear to give any extra power of resistance to the disease.

So far as regards Leicester, Biggs considers that some fatal influence (e.g. vaccination) has interfered with the improvement set in with the introduction of sanitary measures.

James (21,175), speaking of his Bermondsey experience, says that small-pox has been commoner in insanitary houses, while Ward (21,823) believes that with a vigorous sanitation in a large aggregate of individuals small-pox is impossible, i.e. catch the first case and stamp it out.

Wheeler (V.C. 19,843 and *seq.*) tries to make out that the poorest people in Sheffield suffered most on this account rather than on account of their unvaccinated condition, and he quotes a certain district (20,086) as having suffered in previous epidemics, but

his tables show that small-pox does not display the steady decrease of fever, &c., which may fairly be taken as an index of the better sanitary condition (20,120), whereas he states 'small-pox is not under control like the others are.'

Ritchie (*Lancet*, Oct. 7, 1899) quotes the example of Manilla where the sanitary conditions were vile, but where, since the American occupation, over 50,000 persons had been vaccinated. 250 small-pox cases per month in epidemic times during the Spanish occupation had not been considered excessive, but nothing approaching that number had been reached since vaccination had been practised to the greater extent.

Cotton-waste has also been ascribed in the N.S.A. as a vehicle (*B. M. J.*, 1899, ii. 103), while an outbreak in Ashford was put down to infected rags (*B. M. J.*, Oct. 24, 1891), and the occurrence of small-pox in a furniture shop has been ascribed to a load of hair from a part of Kent where the disease was prevalent.

CHAPTER II

AERIAL CONVECTION

THE effect of a small-pox hospital has been held to be detrimental in the way of depreciation of property, and actions have in times past been entered against the Metropolitan Asylums Board, in regard to the Hampstead Hospital, on account of this damage, as well as its influence as a centre of disease, but in another court an action against a hospital under the section dealing with offensive trades met with no success.

In recent years the question whether it may be a centre of infection to the neighbourhood in which it is situated has become one of importance to many a sanitary authority anxious to provide isolation for this disease, for acting on the assumption that the aerial convection of small-pox is an active factor in its dissemination, the Local Government Board will only sanction loans for the erection of a hospital for this disease when there is no hospital or similar institution within the quarter-mile radius from the site, and with less than 200 people within this boundary, while there may be only 600 people within the half-mile radius. The difficulty of finding such a site within an accessible distance of a town is often extreme, although the usefulness

of such a hospital depends much on its accessibility. It was no doubt due to this that at Willenhall the requirements were somewhat relaxed (*Lancet*, 1894, ii. 36). The trouble is not over even if the Local Government Board approve, for there may be villages where they may behave as they did at one near Gloucester, at which the inhabitants met together and burned the place down.

The Commission on small-pox hospitals, which was appointed in 1882, came to the conclusion that the concurrent increase of small-pox in the neighbourhood was connected with the presence of these institutions, and from the numberless reports on the subject there does not seem to be any doubt but that a hospital may be, and often is, the cause of a special incidence of the disease on the surrounding district, but the controversy as to the cause of such spread centres round the possibility of the virus either being conveyed atmospherically, or by the greater opportunities which exist in a district so circumstanced for the personal conveyance of infection, in other words whether it is controllable or uncontrollable.

The records of the Paris hospitals forty years ago abound with instances in which patients suffering from other diseases were infected by variolous persons who, at that date, do not appear to have been segregated to any extent.

It also happens that after the admission of small-pox patients to a general fever hospital, the disease has spread to the wards set apart for scarlet fever, &c.

An instance of this occurred in 1893 in Leicester, where Dr. Priestley reports that ten children who, on account 'of the close proximity of the scarlet fever and small-pox wards,' contracted the latter disease. Browning, however, states that at Haslar the infection did not so spread to the other wards (Q. 4273), and Collie from his Homerton experience confirms this (Q. 4283).

At Sheffield in 1887 a girl was discharged as cured from the scarlet fever ward, and four days later she was taken ill with small-pox (V.C., Q. 1920); and an older patient was also attacked in a similar way.

Among other agencies in the spread of the disease from the hospitals are mentioned the passage through the adjoining districts of the patients and ambulances, the visits of tradesmen, and the communication between officials and the surrounding population. Besides this there will be agencies connected with the hospital as with any other focus of the disease, namely, the possibility of the infection of persons in the neighbourhood as well as at a distance by the visits of friends to the inmates, and the exposure of infected clothing.

It is found that persons working at a small-pox hospital not infrequently contract the disease, although not near the wards. Richards (*Public Health*, 1893, 345) mentions the case of a bricklayer at the Nottingham fever hospital who got small-pox, although he did not seem to have been in contact with the cases.

There can be no doubt of the danger of workmen engaged in putting up buildings in and near small-pox hospitals. In Dartford in 1901-2 there were 247 cases; out of these ninety-six had been employed in one way or another at Long Reach or Gore Farm Hospitals, and forty-two cases occurred in houses where such individuals had been lodging. Not only in Dartford was seen the result of this feverish activity on the part of the Metropolitan Asylums Board, for in the earlier months of this year it was a common thing to find among the London cases a note to the effect that the person attacked had been working at the new hospitals.

Haygarth, in the eighteenth century, is reported to have described an outbreak among some carpenters working by the side of a river 1,500 feet wide, on whose opposite shore were some small-pox huts (4918). Yet this same observer brings forward instances to prove that the disease spreads through personal contact and not by aerial convection.

So far as London is concerned, although previously, and especially in Hampstead there had been many serious allegations as to the spread of the disease from the small-pox hospitals, matters reached a climax at the end of 1880, when public attention was drawn to the abnormal prevalence in the neighbourhood of the Fulham hospital. This institution had been receiving small-pox patients on and off since 1877, from which date a marked increase had from time to time occurred in the prevalence of the disease in its

neighbourhood. After remaining closed for some weeks it had been reopened for the reception of persons suffering from small-pox on December 13, 1880. Mr. W. H. Power (*Local Government Report*, 1882) was deputed to inquire into the truth or otherwise of the complaints, and from his investigation, in which he tried to follow up each individual case, whether public or private, he arrived at the conclusion that there was a special prevalence of small-pox in those portions of Chelsea, Fulham, and Kensington situated within a radius of one mile of the hospital as compared with the rest of those parishes, (those portions of other parishes which are within the mile radius being apparently omitted), that the cases did not follow the lines of human intercourse, that there was no defect in the administration of the hospital that could sufficiently account for the spread of the disease (Q. 901), that a comparison of recent epidemics shows a nearly constant relation between the amount of hospital operations, especially a sudden increase in the number of acute cases (Q. 921), and the prevalence of small-pox. In a later report issued by the same body in 1884, he comments on a new factor which appeared in this outbreak that he investigated, namely, that the excess of small-pox incidence on a neighbourhood was most remarkable when the total admissions to hospital had not exceeded nine. He further notes that the atmospheric conditions obtaining in June, 1884, were almost identical with those of January, 1881; especially in the fact that ozone was practically absent,

Gull thinks the aggregation of cases to be a most important factor, so that a large dose of the poison may be possible.

Gwynne (*Society of Medical Officers of Health*, 1885), reported that the incidence on the neighbourhood of the Hampstead hospital showed a great diminution when the hospital was closed, although in other districts the disease prevailed much the same as before. Pearson Hill also showed that the proportion was greater round the small-pox hospital which he considered was situated in a good part of Hampstead, with plenty of open space; he also agrees with Gwynne as to greater prevalence in the vicinity on the opening of the hospital. Moir and Power (*Ep. Soc.*, 1886) report in their opinion that the outbreak of small-pox in the reformatory at Boleyn Castle and also in West Ham generally, was due to aerial convection from the small-pox hospitals situated at Plaistow. Evans (*B. M. J.*, Aug. 18, 1894) brings evidence to show that at Bradford the opening, closing, and the subsequent reopening were followed respectively by a spread, a lull, and a recrudescence in its neighbourhood, and in this town the complaints were so numerous that the authorities promised to remove the institution, while similar complaints were made of the presumably aerial convection of the sickness at Calverley, Leicester, and other localities. In describing an epidemic at Port Said in December and onwards in 1900 (*Gaz. Hebd.*, 1117, 1901) the danger is pointed out of putting a large hospital for infectious

cases in the midst of a working-class population, and mentions several cases occurring in the neighbourhood of the hospital.

Dr. Farr, the Medical Officer of Health for Lambeth, gives, in his evidence before the Commission, tables showing the striking incidence of the disease on certain parts of his district contemporaneous with the admission of small-pox to the Stockwell Hospital. Certain streets indeed were attacked in each of the epidemics when that institution was receiving cases.

Aveling, although he does not believe in the evil effect of proximity to a hospital, describes seventeen cases in eleven years out of a (S. P. H. C., 5037) population of about 450, who contracted the disease in the City of London Workhouses, which adjoin the Homerton Hospital, but which suffered no more than the Hackney Union, which is a quarter of a mile off (Q. 5034).

Chalmers, in his remarks on the behaviour of small-pox in Glasgow, says that in each year of small-pox prevalence the proportion of cases contributed by the Eastern district has been uniformly in excess of the proportion of resident population. The Northern, Southern, and Western districts have also presented a similar excess, but occasionally only, in contrast to the uniform excess existing in the district near the hospital.

Patterson states that in Chadderton 178 cases occurred within the mile radius of the hospital, while there were only twenty-four in the remaining district.

Airy (*Local Government Board*, 1881) reports on a case of small-pox in a country district where the only source of infection appeared to be aerial convection over a distance of over 200 yards.

Cotton (*Small-pox Hospital Commission*, Q. 3992) states that there was an especial incidence on one particular court which was so close to the hospital grounds that it would be possible to shake hands with some one there.

Tattersall (*Public Health*, vii. 424) brings forward statistics to prove that the proportion of untraced cases within the radius of one mile was greater than when the same hospital was used for convalescents only.

In 1901 there was considerable alarm among the guardians at the small-pox at Purfleet and West Thurrock, the existence of which they ascribe to the presence of the hospital ships in the Thames just opposite.

The excessive prevalence of the disease in the Orsett Union in Essex, and especially in one part of it, West Thurrock, which is within the three-quarter mile radius of the hospital ships in Long Reach, as compared with the rest of the county during the epidemic of 1901-2, did excite some fear at the time, and led to an investigation on the part of the County Medical Officer, as well as one by Dr. Buchanan for the Local Government Board.

They both came to the conclusion that aerial convection from the hospital ships played a considerable part in the dissemination of the disease.

That there were other factors at work, apart from the supposed effect of the aggregation of cases in the hospital ships, is fairly obvious from the table given below.

The number of cases as compared with the greatest number under treatment in the Metropolitan Asylums Board Hospitals was as follows :—

1901.	M. A. B.	West Thurrock.
37th week	131 cases	2 cases
38th "	151 "	1 case
39th "	158 "	2 cases
40th "	167 "	0 "
41st "	171 "	4 "
42nd "	169 "	0 "
43rd "	168 "	0 "
44th "	158 "	3 "
45th "	90 "	0 "
46th "	109 "	1 case
47th "	134 "	14 cases
48th "	128 "	3 "
49th "	134 "	3 "
50th "	167 "	6 "
51st "	151 "	3 "
52nd "	177 "	7 "

Taking the incubation period of small-pox as twelve to fourteen days, we should expect if the increased prevalence were due to the greater number on the ships that weeks like the 41st, 42nd, 43rd and 44th would show a largely increased number, while a con-

trary result should be shown in the 47th. Instead of this, however, we find the exact opposite; indeed the table shows no sort of correspondence between the cases in Purfleet and those on the Hospital Ships, and lends no support to MacVail's theory that the phenomena of aerial convection are more remarkable with a rising epidemic. On the other hand, it does not preclude the effect of an unrecognized case in the district about the 45th week. The addresses of those attacked during the early part of the outbreak are by no means incompatible with the theory that there was some connexion between them, apart from the hospital influence, while so far as the period when the epidemic assumed greater proportions is concerned, Dr. Buchanan states that 'minute inquiries for possible local sources of infection in individual cases of small-pox as they arose were seldom instituted.'

Thresh admits that there may have been surreptitious communication with the Essex shore; and a man employed at the ships was said to have paid visits to his sweetheart, who lived there. The little episode is, however, denied by the parties concerned.

Thorne-Thorne, in his report on hospitals (*Annual Report, Local Government Board*), quotes Leeds and Nottingham as two places where, although diligent inquiry was made, there was no evidence to show that the small-pox hospitals were concerned in the spread of the disease, and he states that in two-thirds of the cases other sources could be established (Q. 1042), but the value of the inquiry is discounted

by the fact that it was made long subsequent to the epidemic. At Stockton and Maidstone the hospital, which was a private house, might have been held to have been a source of infection, and he admits that there was some evidence as regards the spread of small-pox round a hospital, and further opines that it would not be safe to plant a small-pox hospital in the centre of other houses, no matter how perfect the (Q. 1152) disciplinary arrangements.

Sykes, in remarking on the diminished mortality in London, ascribes it to the policy of the Metropolitan Asylums Board in removing the small-pox patients to the ships instead of to urban hospitals.

Ackworth states (*B. M. J.*, ii. 731, 1894) that neither at Buda-Pesth nor Vienna are there anything like the stringent regulations that are insisted on in England; for instance, in Vienna the small-pox ward is 200 feet from an ordinary one, but the discipline is apparently military in its severity, no visitors being allowed. The Commission on Small-pox Hospitals would seem to be in accord with the foreign practice, for they assert that a limited number of small-pox cases under proper conditions (the crucial point of the question) may be kept within the precincts of a general hospital.

Dr. Priestley read a paper practically summarizing his report, to which allusion has been made, at the Congress of the British Institute of Public Health in 1894. This was followed by a discussion in which the majority of health officers certainly gave some

striking examples of absence of spread to the neighbourhood, especially in Birkenhead, Exeter, Portsmouth, and Coventry, where the Medical Officer of Health was able to give experience of two epidemics, one in 1872, and the other in 1893.

Scurfield also brought forward evidence against the theory of the aerial convection of small-pox in Sunderland in opening a discussion at the Northern Branch Meeting of Medical Officers of Health, May 30, 1902, and his opinions were supported by many of the neighbouring medical officers.

Armstrong (*Society of Medical Officers of Health*, 1885) also reports no special incidence on the neighbourhood of the Newcastle small-pox hospital, other replies to the same effect being received from Bristol, Birmingham, Birkenhead, and Warrington.

So far as Nottingham is concerned, Seaton (*Epidemiological Society's Transactions*, ii. 1882) states a large factory escaped, although almost in the hospital grounds, during an epidemic of over eleven months, and that a number of unprotected persons were engaged there. The workhouse, which was close by, also escaped.

Brydges (Q. 634) states that there was no more small-pox at Highgate Infirmary (400-500 inmates), which is situated 200 feet from the small-pox hospital, than round other infirmaries in London; and this may be held as evidence against aerial convection, for the inmates, owing to their condition, would be more liable to be infected through the air than in

any other way, and no special measures were taken to re-vaccinate them.

Collie put up a temporary hospital with nineteen cases, and no cases occurred within 800 yards, although there were a number of inhabited houses.

Murphy, in describing the influence of the Highgate hospital, mentions one case in the Central London Sick Asylum for which no explanation could be found, and deposes that there were streets near the hospital which suffered more severely than the majority, and also there were other streets further away in which there were as many cases. He concludes that the matter is one for watching rather than the drawing of any conclusions.

Colin (*La variole*, Paris, 1873), writing on the small-pox hospital at Bicêtre during the siege of Paris, and its influence on the surrounding population, states that in 1870-1 about 8,000 cases were treated; the soldiers in the Bicêtre fort, which was situated at a less distance than 100 metres from the hospital, were no more affected than those in the other forts surrounding Paris.

The cogency of this argument is, however, somewhat diminished on account of no details being given as to the amount of vaccination of these soldiers; but this objection does not hold good in another instance that he quotes as having occurred at Joigny, where none of those who lived near the hospital were attacked, although vaccination had only partially been carried out.

Paget, in his report on small-pox at Salford in 1892-3, after carefully inquiring into all houses invaded by small-pox (twenty-five in number) that had occurred within a radius of three-quarters of a mile of the Wilton hospital, from the day that it was opened on Jan. 24, 1893, found that in six instances the source of infection could not be traced, while after the opening of the Mode Wheel hospital eight cases occurred within the half-mile radius, and in each there was a more obvious source of infection than that from the isolation hospital. Bristowe, in a report made to the Vestry of Camberwell in 1882, pointed out that there certainly had been exceptional mortality round the Deptford Hospital in No. 4 ward, but he states that this excess existed before the hospital was built, and also when it was closed in December, 1876, and January, 1877, and that he was not satisfied that the cause of spread had been investigated so thoroughly as it might (*Society of M. O. H.*, 1884, p. 110). Dr. H. W. Pink states that the official number of cases was no greater in those districts far removed from the hospital (5,290), and that the epidemic appeared in Greenwich when the hospital was closed. In fact, he considered the hospital to have been an advantage without any counter-balancing disadvantages. Bourneville reports in somewhat similar strain in regard to the excessive mortality round the Sorbonne, which did not exist round the other small-pox hospitals, and which was probably augmented by defective hygiene.

In the recent Liverpool epidemic there was some prevalence in the neighbourhood of the hospital; but the outbreak occurred twelve days before its opening for the reception of cases. Littlejohn (*Report*, Edinburgh, 1904) says that there are institutions with a population of about 1,600 persons within 200 yards of the small-pox hospital. The prevailing wind last year blew from the hospital to the locality concerned, yet the three cases which occurred in them had been exposed to infection elsewhere. (See also *Report of Nottingham M. O. H.* as to freedom round small-pox hospitals, in spite of confident prediction to contrary.) There is mentioned (*B. M. J.*, i. 41, 1888) a report by Dujardin Beaumetz on a recent epidemic at St. Denis, where it was alleged that the small-pox hospital had been concerned in the spread of the epidemic; he states that before the opening of the hospital the malady already existed in the district, and he gives as his opinion that the infection was brought out by patients when they left. Sweeting states (*S. P. Hosp. Com.*, Q. 5200) that the infection in some of the cases round the Fulham Hospital was traceable to the East End. Tripe (Q. 579) says that in the streets near the Homerton Hospital in 1876 there were thirty-five cases per 1000 within the quarter-mile radius, within the half-mile radius twenty-three per 1000, while in other streets of a similar character as regards houses, but distant from the hospital, there were not eleven cases per 1000. Collie (2045-6), in answer to this, states that Homerton Hospital was closed from September, 1874, to

June, 1876, and from July, 1878, to March, 1879, yet at those times small-pox existed in the district. He further points out the changes taking place in Homerton as regards the character and conditions of the population, and considers that to this is due the increase of small-pox cases, and emphasizes this contention by the fact that in the lying-in wards of the City of London Union there would be a number of susceptible infants who would not at once be vaccinated, and whose subsequent history would be known, and where there was no evidence that they had especially suffered.

The ward referred to is within ninety feet of one of the small-pox blocks, where the windows are constantly open, and on two occasions of four months each, there were forty small-pox beds occupied. No case arose in the Union, where vaccination and revaccination do not seem to be carried out to a greater degree than usual (Q. 2164).

Browning says that no case was traced to a small iron hospital, close to a park, where thousands of people were constantly passing, simply because no one went out from this institution till all infection had ceased (Q. 4223).

As is known, practically all the South London cases are removed from the South Wharf, and as in times of fog there was in the last epidemic often a considerable aggregation of cases, so much so that for the purpose of the theory of aerial convection, it may on these occasions be considered a small-pox hospital.

In the epidemic of 1901-2 there were three occasions when there were cases aggregated from this cause, i.e. November 4-6, November 15, 16, March 4-6. The numbers approximately were twenty upwards, while 120 patients are estimated to have been there on March 5.

Dr. Brown, the Medical Officer of Health for Bermondsey, in his report, points out that so far as his district was concerned, there were only three cases that occurred in this neighbourhood. These were at the end of a street furthest from the wharf; and further that on these occasions of aggregation the wind blew from the houses to the wharf. It may be objected that persons may have been attacked who simply work near this wharf, and who live elsewhere; but in the reports of the London medical officers I can only find one instance, namely, that of a man who lived in the direction of Wandsworth.

There are, then, arguments in favour of and against aerial convection, but in addition, to certain general conditions which I presently propose to mention, it would appear that the facts, as noted by Paget, Seaton, and others, of no undue incidence on the neighbourhood, weigh considerably more than the cases cited by the supporters of the theory, since the arguments of the latter on the influence of the hospital depend on the impossibility of finding another source of infection (see also Dudfield, *S. P. Hosp. Com.*, 1491), while the former say more obvious sources are found, or the neighbourhood has escaped.

If aerial convection be an established fact, it should show its influence round each and every small-pox hospital, in effect, as Gull puts it, that dissemination through the air should act at all times (4342).

So long as there are nurses and porters, they will have their friends outside, and all the regulations in the world will not keep them in. The medical officer of Health for Bath in his 1902 reports concerning cases of small-pox which occurred in that city, and which were ascribed to a cloak from a small-pox hospital nurse having been sent to her sister as a gift, says: 'Inquiries were made concerning the system of disinfection carried out at the hospital boats, and there can be no doubt that if the regulations of the hospital had been followed the cloak could not have carried infection.'

Sir E. Currie, in his evidence before the Commission, stated that the nurses employed in the hospital were in the habit of meeting and walking in the lanes round Darenth and Dartford. Collie, however, does not know of any cases where a nurse conveyed infection except in two doubtful instances (Q. 2055). Pink also in his evidence complains of the facilities for the spread of disease through intercourse with the ship *Atlas* (*S. P. Hosp. Com.*, 5320).

Scovell (V.C. 29,331) admits that Metropolitan Asylums Board servants have once or twice carried infection up to London, and also to neighbouring parts.

Philpot (*S. P. Hosp. Com.*) stated that the hospital at Croydon has undoubtedly been a source of danger.

He subsequently discovered that there had been surreptitious visiting by the hospital staff, which he is inclined to regard as the special cause of greater prevalence round the hospital. On the other hand, small-pox has spread in localities near a hospital where there would not be any likely communication with the institution (Q. 4061), but these were frequently lodging-houses where people would have remained no long time.

A young woman caught it at Fulham from the porter she was courting (Q. 1197).

There can be no doubt that unsuspected maladministration, and ill observance of rules, have each of them been responsible for outbreaks; an instance in point is one which is reported in *Public Health*, vi, where a washerwoman contracted the illness from some bedding supposed to have been disinfected.

Barry (V.C., 2217) states that the administration at Sheffield was so bad that infection could have been spread apart from all questions of hospital influence.

It must be borne in mind that in most inquiries into this matter all cases of small-pox occurring round a small-pox hospital, if no other source of infection can be traced, are assigned to the malign influence of the hospital, and usually to aerial convection, yet the impossibility of fixing upon a source of infection twelve days back unless something occurred to mark the occurrence in the sufferer's mind, must be obvious, besides this in a varying, but always a large number of instances, leaving apart all question of aerial con-

vection, no history of infection can be found. In *Bulletin des Hôpitaux*, iii. 31, is described an epidemic started by an attack in which there was no history of any previous contact with infection. It does not therefore seem reasonable that all those cases which occur within a given radius of a hospital should be treated as having arisen from that place, simply because no more obvious source of contagion can be traced. Dudfield quotes some very instructive instances on this point, and he states that the proportion of unaccountable cases were no greater round the hospital than elsewhere (*S. P. Hosp. Com.*, Q. 1595, and elsewhere); and he further makes the statement that there was a large amount of outgoing during the period under review, and that there was a corresponding increase in the cases for the whole of London.

Round a small-pox hospital are more likely to be found the poorer classes (Q. 1299, 3068, 3188, 4025), who, as experience has shown, are the most prone to neglect the vaccination of their children (Q. 1342, 5482), so that adjacent to an institution of this sort there is a relatively large number of susceptible subjects, together with a greater prevalence of overcrowding. Not only this, but it is in such neighbourhoods that mild cases of small-pox are likely to remain absolutely unisolated through being partially or entirely overlooked, on account of the ill-defined symptoms, only the more marked cases being removed; and, as has been pointed out, the number of removals previous to the coming into force of the

Notification has been taken as the number of cases. The evidence in Fulham showed that outside the three-quarter-mile radius the houses were of a superior class, and at the same time the concentration of population that exists within the smaller radius was here lacking.

Makuna (Examination of the aerial convection of small-pox) points out the fallacy of the admissions to the hospitals being taken as a criterion of the incidence of the disease, for it takes no account of concealed cases, and the evidence given by Dr. Bristowe during his examination before the Commission goes far to strengthen this argument, for it is apparent that at that time the intimation of the existence of the disease to the Public Health Authorities was necessarily incomplete (Q. 454). Tripe (Q. 579) and Bridges (Q. 682) agree as to this. Godrich (Q. 1192) refers to reports of concealed cases, and further goes on to say that he has known doctors to pronounce it chicken-pox when they ought to have known it was otherwise. Bostock also gave evidence to a similar effect (Q. 1276. See also Dudfield, Q. 1491, and Collier, Q. 1750 and 1804); while Farr goes so far as to say that he has known twenty-three cases occur in one street as the result of a concealed case.

The evidence, therefore, in pre-notification days on either side is seriously discounted by the fact that cases may have escaped the notice of the authorities, for a correct enumeration is not to be attained by taking notice only of the removals.

Removal to hospital is far more frequent among the artisan and lower middle classes than among the well-to-do, hence if streets around the hospitals happen to contain among their inhabitants a large population of this class the more likely is there to be a comparatively large number of admissions to hospital from such addresses. A recent report by Reece shows the incidence per 10,000 houses in Liverpool to have been greater round the hospitals when they were used for the reception of small-pox cases; but as previously mentioned houses (near the hospitals) are usually poorer and more likely to be overcrowded, so that a relatively large number of persons within the area would be available for attack.

The varying conditions of the wind and weather, which must enter largely as a factor if the small-pox contagion be particulate, are held by different observers to fit in with the theories of aerial convection, but there is a somewhat startling difference in their conclusions.

Power, for instance (Q. 910), says that calm weather favours a gradual dropping down of the virus upon the neighbourhood, and that conditions of the atmosphere which would favour this quiet dissemination of the poison were frequently followed by outbursts of the disease near the hospitals; but Sweeting (Q. 5275) gives January 2-4 and January 20-24, 1881, both inclusive, as periods when similar meteorological conditions prevailed without any increase in the suspected area within the expected time. McVail would

also pin his faith to a foggy atmosphere and light winds (*Epid. Soc.*, xiii). Other observers, however, contend a wind much more readily favours the conveyance of the poison of the disease. Buchanan and Thresh remark that the cases in Purfleet (1901-2) were almost directly in the line of the prevailing wind as it blew over the hospital ships moored in Long Reach, and those parts of the village out of this path suffered less severely. The former writer notes that in the earlier parts of the epidemic the weather was more or less calm and windless, but the period as a whole was not remarkably free from wind.

Curiously enough, at the probable time of the infection of the first case in that village the wind, being easterly in direction, was blowing from the residence of this patient to the ships.

Priestley in endeavouring to explain the fact that a certain district near the hospital in Leicester did not suffer at both of the points of great prevalence of the epidemic, states that only in the second outbreak the direction of the wind was from the hospital to the district affected.

In Glasgow, however, where Dr. Chalmers published spot-maps for various periods it often occurs that the cases are so scattered round the hospital that it is impossible to quote the wind as either for or against the aerial convection theory, but in the fourteen days ending March 9, 1901, there is a striking example of the direction of the wind giving no support to this theory of infection. In this fortnight nearly all the

cases were from the SW. to the NE. of the hospital, with an especial prevalence in the quarter a little to the N. of W. The wind was W. for eight days out of the previous twelve, and on only two days was it from the E., which would have been at all favourable for wind dissemination, while the wind which could most have conveyed the infection, viz. SE., was conspicuous by its absence.

On the other hand, the distribution of the cases in the fortnight ending January 26 might be held to be due to the influence of wind, for it was blowing from a favourable quarter for nearly the whole period, during which infection might be conveyed.

Evans (*B. M. J.*, Aug. 18, 1894) in describing the effects of the wind in the Bradford epidemic states that the wind was westerly on 250 days of the year, while the greater number of cases occurred to the east of that institution. But it is in all cases necessary to know whether it is SW. or NW., and whether the epidemic is to the NE. or SE. of the hospital. Reece (*Liverpool Epidemic*, 1901-3) does not mention any condition of wind, &c., which would in his opinion have favoured the spread of the disease.

Any cases, however, in which the special incidence is to the north-east of any hospital should be rather discounted on account of the prevailing wind being from the south-west.

In Purfleet, however, it is clear that if aerial convection were of importance as a factor it was able to exert its influence both in calm and windy weather.

It would therefore seem more likely for some other causes, such as personal contact, to be the cause of the spread.

It has been stated above that when the hospital at Hampstead was closed there was a diminution in the amount of small-pox, but Mr. P. Hill states that there occurred a lull in the neighbourhood even while the small-pox was in full work (Q. 1682). He gets out of this difficulty by assuming that a particular state of atmosphere (Q. 1689) is necessary, and McVail suggests that as the aerial convection of small-pox is not assumed with such positiveness to exist in country districts as it does in towns, that a country atmosphere does not permit of the dissemination in that way, a theory which hardly fits in with its supposed occurrence at Purfleet. Indeed, from the diversity of views on the subject of weather influence it would seem as if those existing at the time of the supposed aerial convection are those picked out by the supporters of that theory as especially favouring it.

The same divergent views that exist as to the influence of the wind also exist as to whether the vicinal increase is greater when there are many or few cases in the supposedly offending institution, but it would appear, other things being equal, that the more cases are aggregated the greater would be the amount of poisonous material available for dissemination. This was not so, however, at Fulham (Q. 5469). McVail considers that aerial convection is more likely

to occur with a rising epidemic, since there would then be a larger number of susceptible persons open to attack, but that no good evidence existed of outbreaks in rural districts from this cause. This is not, however, the experience of Purfleet, where the great increase was not immediately shown. Besides this there is another difference of opinion as to whether the acute cases are more capable of spreading the disease, or whether the supposed property is shared to an equal degree by the convalescents.

As it has so often been remarked, it is impossible to prove or disprove aerial convection, but only to estimate the weight of evidence. In the observations of those who favour this view there appear to be many opportunities for doubt as to its correctness, for the divergent views as to the effect of the atmospheric conditions, the aggregation of cases, coupled with the difficulty of eliminating other sources of infection, and with the recorded instances of absence of excessive vicinal prevalence in many instances and especially where the discipline has been strictly carried out, seem to point to the theory being far-fetched.

In future it is to be hoped that seeing the doubts that have been shown to exist as to the aerial convection of this disease the Local Government Board will allow some relaxation of their previous rules, and will be guided rather by the likelihood of precautionary regulations being strictly observed than by the isolation of the hospital, a matter often both costly and difficult.

CHAPTER III

THE PREVENTION OF SMALL-POX

TEN or fifteen years ago the preventive treatment of any infectious disease would have been summed up in the three words notification, isolation, disinfection, with the addition in the case of small-pox of vaccination and re-vaccination. In recent years although the faith in the two last is still held more than ever and is justified by recent experience, there is an increasing tendency towards the disparagement of the second, at least so far as the segregation of cases in hospital is concerned (*Lancet*, Aug. 27, 1904). The principles of notification, &c., themselves may be at fault, or their comparative non-success in some diseases may be attributable to insufficient observation of their essential principles. In the provision of isolation, for instance, some authorities say that the present system is wrong, and they bring forward figures to prove that matters would be much improved if separate accommodation could be provided for each patient.

Although at first opposed by the profession throughout the kingdom a system of notification was reported to the Small-pox Hospitals Commission as having been in force in Edinburgh so far back as 1881, and it was when it had appeared to produce salutary

results that similar systems had been adopted in Leicester, Huddersfield, Bolton, and Blackburn (5093). Hastings in his evidence quotes a report by the Medical Officer of Health of Bolton showing that for ten years subsequent to the notification the mortality from small-pox had fallen from 12.0 per 1,000 down to 4 per 1,000, and a reduction had also been observed in the case of scarlatina.

Many witnesses before this Commission gave evidence of the spread of infection through the authorities being ignorant of the existence of small-pox in any given place. Indeed whatever doubt there may be as to the good done by notification in other diseases there can be but little so far as small-pox is concerned. On the early diagnosis depend the advantages of notification, combined with the use that is made of such information. This in some measure explains its failure as regards measles (Armstrong, *Special Report to Newcastle Sanitary Authority*), its comparative non-success in scarlet fever, and the especially good results obtained in the last epidemic of small-pox. It allowed of prompt inter-communication between Medical Officers of Health as to contacts, the vaccination of such contacts as desired, it being carried out sufficiently early to exert some influence on the disease, and the subsequent early detection of disease in those who had been exposed to infection.

Haygarth, in the year 1777, after coming to the conclusion that small-pox was always communicated

by infection, says that the other members of the family may be saved by immediate inoculation or by separation. Canon D'Oyley in a sermon in 1766 speaks of the necessity of the removal of poor persons from their neighbourhood; and isolation was no doubt in use in other diseases at an earlier date, for the cutting off of the leper dates from biblical times, and the presence of leper windows in old churches show that attempts at isolation were made in England many centuries back.

So far as the plague of 1666 was concerned Boghurst's advice is an inversion of the present fashion, for he advises that all those who can should themselves remove from the source of infection. He mentions as a common practice the washing of money and letters, and the distrust of persons in the country with respect to clothes from London. Hillary writes much in the same strain, but if sick persons have to be attended he advises for their attendants a course of antiphlogistic purging physic and a contented easy mind.

In the report of the Commission on Small-pox Hospitals are found strong statements as to the value of early removal to hospital of small-pox patients, and later, while pointing out the difficulties that may arise in the course of removal, they recommend various things which are now embodied, so far as London is concerned, in the Public Health Act.

Before the establishment of the Metropolitan Asylums Board by the passing of the Metropolitan Poor

Law Act, 1867, the various local sanitary authorities of London could only make their own arrangements for the reception of such infectious patients, which could not be admitted into their institutions for the sick.

The Metropolitan Asylums Board, which was formed in 1867 to deal with infectious disease, &c., among paupers, is a body to which delegates are sent from the various Boards of Guardians, with the addition of some members appointed by the Local Government Board.

But that in recent years they are not chiefly concerned with paupers, so far as infectious disease is concerned, is proved by the fact that even in 1882 nine-tenths of the patients received into their hospitals were not of this class, and, judging from the class of house from which infectious diseases are removed, the percentage would now be higher.

Several witnesses before the Small-pox Hospital Commission seemed strongly to opine that the Metropolitan Asylums Board should be under the control of the Health Authorities, and not those concerned with destitution (Q. 4540).

There is thus an essential difference, which amounts to a defect, between the arrangements of London and the other big centres, where the Sanitary Authorities are themselves the governing bodies of the infectious hospitals. Only in London, indeed, with its many anomalies of administration, would such a system have been allowed to exist.

THESE TABLES APPEAR IN SIR THE HEALTH OF THE

SCARLET FEVER.

Period.	Doath-Rato per 1,000 living.	Case-Rate per 1,000 living.	Case Mortality per cent.	Percentage of Cases Removed.
1891	0.14	2.7	5.1	47.5
1892	0.27	6.4	4.3	50.0
1893	0.37	8.6	4.3	40.0
1894	0.22	4.3	5.2	64.0
1895	0.19	4.5	4.2	60.0
1896	0.21	5.7	3.7	63.0
1897	0.17	5.1	3.0	67.0
1898	0.13	3.8	3.4	72.0
1899	0.09	4.1	2.2	74.0
1900	0.08	3.1	2.6	75.0
1901	0.13	4.1	3.2	78.0
1902	0.12	3.9	3.1	80.0
1903	0.08	2.7	2.9	83.0

ENTERIC FEVER.

Period.	Death-Rate per 1,000 living.	Case-Rate per 1,000 living.	Case Mortality per cent.
1891	0.12	0.8	15.6
1892	0.10	0.6	17.2
1893	0.16	0.9	18.4
1894	0.14	0.8	18.1
1895	0.14	0.8	17.0
1896	0.13	0.7	17.6
1897	0.13	0.7	18.0
1898	0.12	0.7	18.3
1899	0.17	1.0	17.0
1900	0.16	1.0	16.6
1901	0.11	0.7	15.6
1902	0.12	0.7	15.8
1903	0.08	0.5	15.7

Between pp. 58 and 59.]

HIRLEY MURPHY'S REPORT OF COUNTY OF LONDON, 1903.

DIPHThERIA.

Period.	Death-Rate per 1,000 living.	Case-Rate per 1,000 living.	Case Mortality per cent.	Percentage of Cases Removed.
1891	0.31	1.5	22.5	23.0
1892	0.44	2.0	22.2	25.0
1893	0.74	3.2	23.3	23.5
1894	0.61	2.6	23.6	35.0
1895	0.52	2.6	20.4	33.5
1896	0.59	3.1	19.3	33.5
1897	0.50	3.0	17.0	44.0
1898	0.39	2.7	14.8	55.0
1899	0.43	3.1	14.2	64.0
1900	0.34	2.7	12.8	65.0
1901	0.29	2.7	10.9	64.0
1902	0.25	2.3	10.8	62.0
1903	0.16	1.7	9.6	64.5

MEASLES.

Death-Rates per 1,000 living.		
1891	=	0.43
1892	=	0.79
1893	=	0.38
1894	=	0.76
1895	=	0.60
1896	=	0.82
1897	=	0.43
1898	=	0.69
1899	=	0.48
1900	=	0.43
1901	=	0.43
1902	=	0.51
1903	=	0.44

It is true that the charges can be recovered from those that are not paupers, but if isolation hospitals are so necessary in the treatment of infectious disease it would be in the highest degree unwise of an authority to enforce such a charge.

The tables appended give the case-rate and death-rate for the three chief notifiable diseases since 1891, the year before the coming into force of the Public Health Act, together with the mortality for measles, in which a somewhat perfunctory system of disinfection has been put in force since 1903, but for which no isolation hospitals are provided.

Collins and Picton (*V. C. Report*) rather imply that the lack of decrease in hooping-cough and measles, compared with small-pox, is due to the difficulty of isolation in these two diseases; but this argument cannot apply to scarlet fever, for which in London the percentage of removals to cases has shown a fairly steady increase since 1891, and it now reaches the large proportion of 80 per cent. In the case of diphtheria such a high figure has not been reached, the percentage hardly attaining 65 in the last year.

On reference to the tables it will be seen that neither the mortality nor the attack rate of scarlet fever has shown the progressive diminution which would warrant the inference that notification and the increased amount of isolation have had much influence in bringing about a decrease.

The Statistical Committee of the Metropolitan Asylums Board, in their report for 1889, claim that

the freedom of the metropolis from small-pox is largely due to the rapid and systematic removal of small-pox cases to the hospital ships, a claim also made by Scovell (V.C. 29,175), and apparently supported by Picton and Collins (*V.C. Report*).

In towns such as Leicester, where (P.H. 1893, p. 245) they quarantine and watch persons as well as isolate the patients themselves, the quarantined persons are allowed to walk about, but not to enter any one's house under pain of losing their quarantine money, and Dr. Priestley states that Leicester manufacturers will not have any one back to work during the fourteen days' quarantine period.

During the last epidemic it was the custom to hustle all patients suffering from this disease off to hospital, irrespective of age, sex, and social condition, a carrying out of the dictum of the Metropolitan Asylums Board Managers, who speak of the paramount necessity of clearing the small-pox patients out of London daily, on the supposition that no person suffering from small-pox can be treated at home without danger to the public health. People as a rule have concurred in this, and I am not aware that it was necessary to resort to proceedings for compulsory removal in more than one or two instances.

Carmichael insists that every case of small-pox must be treated in hospital if any grip on the disease is to be maintained; it is less safe for the patient to be at home and more dangerous for the public.

If, however, the danger is so extreme, we should

expect to find serious outbreaks to be frequent where prompt removal has not been resorted to. During the last epidemic those treated at home were few in number, but we can in some measure estimate the danger by considering the cases of those who were not removed for some days after the appearance of the rash (see p. 7).

There will always be a certain number of cases for which the State must provide, just as it does for those of other diseases, but one of the points which presses for solution is whether the removal of all cases of small-pox to hospital as it was carried out during the last epidemic is necessary, and whether its discontinuance would amount to even a menace to the public health.

Leaving for a moment, however, the discussion as to the necessity for this wholesale and universal removal on the grounds of the public safety, it does appear that the indiscriminate mixing of all classes (and especially does this apply to women) is most undesirable and one calculated to increase the repugnance and opposition to removal that occasionally manifests itself. One of the London Medical Officers of Health, in his remarks on a certain group of cases, comments on the fact that a number of them were prostitutes. The Commission on Small-pox Hospitals evidently recognized this when they recommended the separation of those whose habits and language are mischievous to others. Chalmers also refers (*S. P. Hosp. Com.*, 3898) to the difficulty they have from the association of different classes.

It has previously been mentioned that the keeping of a patient at home who is suffering from small-pox, even when unrecognized, has not usually been found to result in the infection of the other inhabitants or the persons in close proximity unless there had been visiting among them, even though the neighbourhood be thickly populated and no reason to believe that it was an exceptionally well-vaccinated one.

There are undoubtedly some conditions under which removal is not necessary, either on the ground of danger to the inhabitants of the dwelling itself or to those who live in adjoining houses. Tripe (*S. P. Hosp. Com.*, 2301) gives as a general opinion that a sufferer can be kept at home provided he can have a floor to himself and separate attendance. In streets where opportunities for indiscriminate visiting exist and are taken advantage of, and especially where there is poverty, removal should, under existing circumstances of vaccination, be insisted upon, for, apart from the overcrowding which usually exists in such neighbourhoods, there is the tendency among the poor, good in itself, but often productive of the spread of disease, to visit and help their neighbours who are ill or in trouble.

On the other hand, cases in houses which are detached, even of the ordinary suburban type, inhabited by people who would be frightened of small-pox, and who would not be likely to foregather in the house attacked, for these isolation at home can be properly carried out. To avoid danger, the people in

the house, on the diagnosis being made, can be protected by being vaccinated. If they are already incubating the disease, isolation by removal of the one first attacked will not save them.

The whole question of the necessity for isolation can be solved by re-vaccination of the population at large. I have elsewhere quoted the experience of Berlin, where twelve beds in a general fever hospital are sufficient for 2,000,000 of a well-vaccinated and re-vaccinated community, whereas Moore (*Twentieth Century Practice*) thinks in urban districts in Great Britain the isolation should be provided at the rate of one bed per 200 inhabitants, Collie's estimate being lower than this.

In London the removal from the patients' homes and conveyance to the hospital ships is undertaken by the Asylums Board in carriages specially designed for the comfort of the patient and the accompanying nurse, a great improvement on the old system when the patients were removed in cabs, and a still greater advance on the plan carried out in Rhode Island in 1778, when they were conveyed in a large box containing a bed, and the sides perforated for a fresh air supply. It is related that 'this formidable apparatus did more mischief, especially to timorous minds, than the disease itself.'

It not infrequently happens that persons may be suspected of sickening for small-pox and yet not show the characteristic rash. How to deal with these cases, especially among the poorer classes, is often

a matter of difficulty, for although the medical man in attendance may strongly suspect the disease he is unable to certify on the evidence that in his opinion it is small-pox, and the ambulance authorities will not remove him unless a definite statement to this effect is made.

Difficulty arises especially where, the diagnosis not being certain, removal to hospital is objected to by the patient or his friends, or where, as most often happens in connexion with large houses of business, the mere suspicion of a case having occurred would be to create a scare which would redound seriously to the pecuniary loss of those concerned.

How far, then, should the practitioner allow himself to be influenced by his suspicions? The previous existence of small-pox is undoubtedly the most important factor, but he should also be guided by the presence or absence of opportunities for isolation, or by the existence of monetary conditions which render it necessary that work should still proceed at the premises in question, and that other persons who have been in the company of the sick must go to their ordinary work.

As stated above, the authorities will only remove on the reception of a certificate that the patient is suffering from small-pox, the diagnosis being reconsidered at the wharf by the Metropolitan Asylums Board Medical Officer. If he should consider that it is small-pox, the patient goes down the river to the hospital and all goes smoothly, but if, on the other

hand, the diagnosis is not confirmed, the sick man is sent home with the dogmatic statement that he is not found to be suffering from small-pox, an assumption of infallibility which has not always been justified by subsequent events.

The effect of this on the doctor's reputation and the certainty of his loss of a patient can be imagined. But apart from this, the disturbance of business, the expense of and possible damage by disinfection, will have been incurred. The distressed practitioner might have invoked the Medical Officer of Health, but that functionary is not compelled to visit, and may even refuse to do so.

While chicken-pox was a notifiable disease in 1904, the London County Council, instead of appointing local consultants for the disease, which had been found to give rise to jealousy between neighbouring medical men, appointed two experts who visited on the request of the medical man in attendance. This was an eminently satisfactory solution of the difficulty, but it is also to be feared that when this disease ceases to be notifiable the practitioner will be left to the mercies of the non-possumus policy of the Metropolitan Asylums Board. At the cost of £300 or £400 yearly it could be arranged for there to be a resident medical officer at the wharf, whose duty would be to accompany the ambulance, and the number of such officers could be increased in epidemic times. To a body like the Metropolitan Asylums Board, which thinks in thousands, the cost would be merely a flea-bite, and if

they have scruples as to the scope of their duties they could salve their consciences with the belief that his presence was necessary in the medical interests of the person about to be conveyed.

Even in the earliest days of medicine, in addition to extraordinary remedies for the cure of the disease, such as the anointing of the face with ox-dung and water, a practice which, according to an old Lancashire sanitary inspector, is still advised in the outlying parts of that county, attempts were made in the direction of a satisfactory fumigation of the room in which small-pox patients were kept. In the time of Rhazes, for instance, the room was ordered to be strewn with myrtle, willow, and pomegranate, and aromatic powders were ordered to be placed on the patient. Whether this was done in the interests of the attendants as a primitive sort of disinfection is not quite clear, but it was probably advised on account of its being of some advantage to the patient himself.

According to the same authority the Indians have a syrup of pearls which, they claim, is so potent as a preventive that although nine pustules may have appeared the administration of the mixture will prevent the coming of a tenth.

John of Gaddesden (*Rosa Anglia*), in a description of his treatment of this disease in the king's son, is silent as to any disinfection; and Paulet, writing as late as the year 1750 (*Enquiry into Small-pox*), says that no preventive measures except inoculation had

been in force up to that time. Haygarth also notes the fact that in the Chester epidemic no steps were taken to disinfect the patients' clothes, and makes various suggestions as to the burning or washing of infected clothing.

Rose (*Essay on Small-pox*), in the year 1727, advises the opening of windows and the lighting of fires to carry off the noxious effluvia.

Although no specific measures of isolation and disinfection are mentioned against small-pox, it may have been practised in the same way as those narrated as being in common use at the time of the Plague.

Even up to quite recent times the power of destroying infection was supposed to be present in many odorous substances, and it seems as if the pungency and unpleasantness of the odour of the article in question were to be reckoned as qualities determining its value. This is not unlikely to be the origin of the idea, which prevailed in Cambridge even so late as 1903, that the keeping of a goat in the house prevented the inhabitants from catching the disease (*Lancet*, ii. 330, 1903). In the case of the Plague Boghurst mentions many extraordinary practices resorted to by the timid, and there is no reason to suppose they were not equally valued in small-pox.

One of the earliest means of preventing the spread of any infectious disease was to burn all infected bedding, &c., and even now it may still be said that the only absolutely safe way to destroy all infection in a house is to burn it down. The money loss, how-

ever, entailed in the destruction of clothing, led to the employment of heat in another form, namely that of steam and boiling water.

Before, however, the application of bacteriology as a standard for properties of various chemicals, disinfection was in an unsatisfactory state. Now, however, that the destructive effects on bacteria can be measured, we are better able to select disinfectants, which although harmless to the material so treated, are destructive of organic life.

The disinfection in small-pox need differ but in quantity from that necessary after scarlet fever. All articles, such as mattresses, blankets, &c., that are not injured by heat and moisture, should be disinfected by means of superheated steam. Fabrics and articles such as books, &c., that would be injured by this method, can be fumigated with formaldehyde vapour. To ensure the penetration of the gas this fumigation should be carried out on the plan employed by Dr. Hopwood at the London Fever Hospital, where the articles to be disinfected are placed in an airtight chamber, to which, after a partial vacuum has been produced, air saturated with formaldehyde vapour is admitted, but the precaution should be taken that the pressure shows a diminution of at least fifteen inches on that of the atmosphere. The walls, floors, and ceilings are to be sprayed with a solution of one in 1,000 corrosive sublimate, while woodwork can be washed over with ordinary soap and water.

The early diagnosis of small-pox in a community

which has not been previously vaccinated and re-vaccinated is of prime importance; this is dealt with fully in the ordinary textbooks, but it is well to remember that in face of a doubtful rash the vaccination marks should be always considered in connexion with the age. If there should be a by no means characteristic rash in an unvaccinated child of four years old the probabilities are strongly against small-pox, but on the other hand, if such a rash were to come out on an adult with good vaccination marks, all the other symptoms should be most carefully weighed in view of the likelihood of its being a genuine case. Secondly, the rash is almost invariably uniform in its development, vesicles not being seen in different stages. This is of course due to the fact that the spots do not appear in successive crops, as they do in chicken-pox. Thirdly, the special predilection of the rash for the face and wrists, where its character is most to be relied on, while the possibility of exposure to infection should not be overlooked.

INOCULATION AND VACCINATION

It is not surprising that attempts have been specially made to lessen the spread of small-pox, which occasionally in the eighteenth century formed a proportion of one to thirty of the total deaths (Leipzig in 1758-63). Apart from its death toll, the ensuing disfigurement and liability to subsequent disorders (*Gaz. Hebd.*, 394, 1899) render it one of the most

serious of diseases. D'Oyley (1776) speaks of the dread which overwhelms a household on the appearance of this malady in its midst. An ancient preventive measure is that of inoculation, which, according to Crookshank has prevailed in India and certain parts of Africa from time immemorial (V.C. 10,332). The writings of the Jesuit missionaries from China state that it was habitually in use there at an early period, and even yet has not died out. In Wales, too, it appears to have been of antiquity, and was there called 'buying the small-pox.'

It had been found by experience that as a general rule one attack of the disease conferred immunity, and further, that the inoculated form of the disease was less serious and more rarely fatal than the form contracted in the ordinary way.

Although it had received some attention from several writers about the year 1715, it obtained notoriety in England through the efforts of Lady Mary Wortley Montague. This lady, who had probably heard of the custom of inoculating the female children in Circassia to secure them from disfigurement, was so impressed with its effects that on her return to England in 1720 she determined to make known its benefits, and she was allowed by Government to allow Maitland to experiment on six condemned criminals. Fashion then, as now, played strange pranks, and it soon became the rage to be inoculated.

Crookshank, on the other hand, quotes authors who

mention the fact that well-disposed parents who had objected to inoculation had purposely exposed their children so that they might contract the disease (V.C. 11,027).

Inoculation had to stand its trial in the same way as vaccination some years after, but only tracts and reports now remain as a memorial of the heated discussions of those days, when even theological and religious objections were used against it (Rose, *Essay on Small-pox*, 1727).

So far from recommending it Douglas (*Essay on Small-pox*, 1730) states that the only prophylactic measure is to fly from the disease and live well, persons being less liable to fall victims to epidemics when 'impregnated with rich food and generous liquors.'

The operation was performed both by the medical profession and by quacks, who seem to have been more successful in their operations than the recognized practitioners. In 1754 the Royal College of Physicians published a commendation of inoculation, and Condamine, writing in the same year in support of the practice, mentions the outcry against it in Paris in 1723, although in 1728 he states that a Carmelite missionary in South America lost so many of his mission from the disease that he inoculated the remainder on the strength of what he had read about the method, and with most satisfactory results; from this one would infer that the practice had become well recognized and approved; in England at

all events the existence of such an opinion is shown by a paper of Aikin (in the *Philosophical Transactions* quoted by Gornall) regretting that in Warrington the practice was so little followed, only about ten persons having submitted to the operation. Yet in 1774 the Vice-Chancellor prohibited, albeit unsuccessfully, its practice in Oxford.

The operation was performed in various ways. The Jesuit Father Escherolles describes the Chinese method of sowing the small-pox by powdering the dry crusts and using them as snuff, while others put threads imbued with variolous pus into open wounds, or punctures were made with a needle and the pus rubbed in.

It was found that an inoculated person, however, was quite capable of conveying the disease to a susceptible person, and in the severest form, and moreover that a small percentage (two) died from the operation. It has been contended by the anti-vaccinators that its practice was responsible for the greatly increased prevalence of the disease in the eighteenth century as compared with the seventeenth, and to its discontinuance and not to the introduction of vaccination must be ascribed the lessening of the disease in the nineteenth century.

It was thus obvious that inoculation had many drawbacks, which no doubt led to the decree being issued prohibiting this practice in Paris in 1763, and men were driven to cast about for other means of combating this terrible disease. Inoculation, however,

was still practised in parts of Ireland in 1875 (V.C. 2839).

About the year 1775, Edward Jenner, then an apprentice to a surgeon in Gloucestershire, is said to have heard a dairymaid remark that she would not have small-pox because she had already had the cow-pox, a disease which had been well recognized for many years in that county.

This remark set him thinking and experimenting, the results of which are seen in his *Enquiry into the Cow-pox*, in which he details a number of persons who had been inoculated with the cow-pox, and who were proved to be uninoculable with the virus of small-pox, or who had not taken the disease when exposed to sufferers, and conversely, when persons had had small-pox they were unaffected by the inoculation of cow-pox, although cow-pox appeared somewhat badly in those who had not suffered from the former, while exceptionally there occurred instances where a previous attack of small-pox only mitigated the severity of the latter.

The protective power of cow-pox had been even previously noticed by others, for he quotes a letter from a surgeon in Stroud who speaks of the difficulty he had in the inoculation of small-pox in those who had had the cow-pox, but there can be no doubt that Jenner was the first to grasp the significance of the fact.

It is surprising how soon the practice was considered to have considerable merit in protecting persons against the attacks of this disease. In 1800,

an advertisement appeared in the *Morning Herald* signed by Abernethy, Cline, Lettsom, &c., to the effect that those persons who have had the cow-pox are perfectly secure against the infection of the small-pox. Woodville (evidence before Jenner committee of House of Commons) reports that of 7,500 persons who had been vaccinated one half were afterwards inoculated with small-pox without any result.

A Committee of the House of Commons started an inquiry in March, 1802, under the chairmanship of Admiral Berkeley, and after examining many witnesses made a report to Parliament with the result of a vote of £10,000 to Jenner, followed by a similar sum in 1807, in which year the College of Physicians in London published a report strongly approving of the practice as a means to put an end to the ravages of small-pox, if not to its very existence.

Several witnesses spoke in their evidence before the Committee in 1805 of the reception it had received in foreign countries, where observers had not been slow in making experiments with a view of testing its value. Odin states that to Geneva belongs the credit of being one of the first towns on the Continent to avail itself of the discovery of vaccination.

Barrey (*La Vaccine*, Besançon, 1808), describing the lack of effect in the experimental inoculation of small-pox after successful vaccination, concludes with a description of the absence of any results from the exposure of infected articles to vaccinated children.

Heunteloup in his translation of the *Milan Commis-*

sion describes many instances of inoculation of small-pox virus after vaccination without any effect.

As might be expected opposition to the practice soon started. Lipscomb in 1805 attempts to prove inoculation to be the surer preventive, while Brown (*Edinburgh*, 1809) quotes several vaccinators who admitted that the disease had occurred after the operation, and even goes so far as to prophesy that the practice will gradually fade into oblivion.

In recent years Creighton from an examination of the writings of those days (V.C. 4865) discredits the experiments of Sacco and Jenner. He would appear to think that the usual effects of inoculation in the production of pustules were so slight that there would have been as little result had the patients not been vaccinated before the test inoculation (V.C. 5044).

On account of the advantages claimed for vaccination by its supporters, and also through the severe and continued attack that it is receiving from the anti-vaccinators, it merits the first place in the consideration of preventive measures. It is in England that the anti-vaccinator appears to flourish, for according to Hopkirk (V.C. 1429) opposition has practically died out abroad. Before setting out the advantages of the operation it is essential to indicate the circumstances under which vaccination does not afford protection against infection.

Masson and Seaton both state that if a person be vaccinated successfully during the first three days of incubation of small-pox he will escape entirely;

if between the third and fourth, it will be modified; while after this the two diseases will be concurrent, and be uninfluenced one by the other.

A. E. Berry (R. M. O. Monsall Hospital, *British Medical Journal*, Nov. 3, 1894) thinks that the operation is truly protective if performed during the first forty-eight hours after infection; W. Berry (*Lancet*, 1898, i. 1079) considers that vaccination performed during the incubation stage of small-pox is without effect.

The vaccination, too, must be successful, that is, must take, producing the proper vesicles and scars, every departure from the normal being supposed by Seaton (*Handbook of Vac.*, p. 76) to be looked upon with suspicion. A large number of vaccinations and re-vaccinations are unsuccessful, sometimes of malice prepense; for instance, reference is made in the evidence before the Royal Commission of sailors sucking the arm after vaccination, and although this practice is referred to as being doubtful (Q. 3511) twenty-five per cent. of re-vaccinations were apparently failures.

Adams in his *Answers to Objections against Vaccination* in 1805, gives three reasons for the occurrence of small-pox after vaccination, (a) imperfect performance, (b) constitution under the influence of another disease at the time, (c) persons being liable to have a second attack of small-pox.

Hence it is unfair for statistical purposes to class under the vaccinated heading all who have undergone

the operation, unless twelve days, the period of incubation of the disease, have elapsed between the date of vaccination and the initial illness, and unless one or more of the characteristic vesicles have appeared. This condition is not always observed by the anti-vaccinators. Wheeler (V.C. 19,659) draws no distinction between those successfully and unsuccessfully vaccinated, and altogether ignores the date at which the operation was performed previous to contracting the disease (19,682), including those who were vaccinated in the incubation period before the appearance of the rash; he would, however, exempt those scratched with a lancet a few seconds before death (19,794).

But there is no doubt that small-pox has occurred within a short time of successful vaccination, just in the same way that a second attack of this disease has followed the first at a very short interval, and even when the first attack was one of some considerable severity; for while it has been found that one attack of small-pox protects against a second, the rule, although so stated by Barrey, is not absolute, for Ross mentions an instance (*B. M. J.*, Oct., 1896; p. 1032) where a girl developed a second attack a few days after her discharge from the hospital on her recovery from small-pox. Herringham quotes from the memoirs of the Duc de St. Simon (*B. M. J.*, 1896, ii. p. 1746), concerning blindness following a second attack; similar evidence being given to the Vaccination Commission by Ward (21,963). Simon says (V.C. 64) that Louis XV of France died of a second

attack when he was quite an old man. Barry also found that in Sheffield .13 per cent. of the total number were second attacks.

Von Kerchensteiner, quoted by Edwards (*Ep. Soc. Trans.*, v. 37), reports having attended a patient who died in a third attack, after he had been under the care of Helva, of Vienna, for two previous attacks; while to go still further back, Forester, in 1522, mentions second attacks of small-pox as not being at all an uncommon occurrence.

Pierce (*Lancet*, Aug. 1, 1903) reports a case of small-pox nineteen days after successful vaccination, the same boy two months later again suffering from a modified attack of the disease.

We are, however, concerned, not with pathological curiosities, but with the ordinary occurrences of life.

As a subject for political discussion, vaccination, termed 'a grotesque superstition,' and the 'introduction of bestial humours,' &c., by its opponents—seems to have as great a power to excite angry passions as vivisection, temperance, or even the Education Act of 1902. It is recorded that under a distress sale at Dewsbury, the vaccination officer was burnt in effigy (V.C. 18,027). In Italy a septuagenarian priest, in order to set a good example, was publicly vaccinated before the inhabitants of a village who had previously threatened the municipality and the doctors with violence on account of the proposed compulsory vaccination. A certain doctor met Moore (*Hist. of S. P.*) in consultation and told him that he would vote

for 'the hanging of all supporters of vaccination, it being the damndest thing ever proposed.'

There is, however, a decided difference in the amount of feeling which is exhibited by the opponents of the practice and its supporters. If the evidence given before the Vaccination Commission be read, it will be evident how impossible it is for the former to imagine any good effect of vaccination, and that it is quite beyond their power to see any other side than their own. Indeed, Lord Herschell was so impressed by their method of answering, that he asked Mr. Wheeler if he thought a pro-vaccinator could be an honest man (V.C. 19,632).

At the time of Jenner it was supposed that one operation protected the individual through life, although Goldson, in 1804, gave it as his opinion, supported by cases, that the protection was but temporary. This opinion, of course, could only be verified or disproved by the lapse of time, and it has been so disproved. In the case of recruits, it has been shown that ninety per cent. of re-vaccinations were successful, showing the effects of the first operation to be transient. Roger (*Gaz. Hebd.*, p. 640, 1897) gives instances of re-vaccination giving two pustules, although the primary operation had only been performed fourteen months previously, and had left the characteristic scars. After ten years, although the infantile vaccination is still able to exert a modifying influence on the disease in reduction of mortality, its power to protect against infection has

largely diminished ; and it is from this age onwards that the contrast so marked in early life between the small numbers of the vaccinated and the large numbers of the other class begins to show signs of a progressive diminution.

The beneficial effects of vaccination and re-vaccination may be divided into four heads :—

- (1) The liability to infection.
- (2) The effect on the mortality.
- (3) The modifying effect as to the disease itself, and the diminution of after-effects.
- (4) The duration of the disease.

From what has been previously written regarding the gradual weakening of the preventive power of the initial vaccination, which, unless restored by re-vaccination, in some persons finally disappears, we should expect to find that the vaccinated children would prove to have suffered less from small-pox than the unvaccinated, and that as we mount higher up in the ages the number of vaccinated persons contracting the disease would gradually increase.

In a town well vaccinated, so far as primary vaccination goes, it is found that a large proportion of unvaccinated persons under ten are attacked ; and it also appears that the incidence among the vaccinated class is on those over ten, i.e. those further removed from the vaccination age.

The decreased liability to infection of children in a well-vaccinated town such as Sheffield, is well brought out by Barry in his report ; taking 1863-4,

when vaccination was not well performed, there being thirteen per cent. unvaccinated and sixty-eight per cent. indifferently vaccinated, discovered on the inspection of a school about this time, and the primary vaccinations being only about fifty per cent. of the births, there were eighty-six deaths of persons under ten to fourteen of those over that age. In 1871-2, when vaccination was more extensively carried out, the proportion had fallen to sixty-four to thirty-six, while in 1887-8 it had altered to the ratio of twenty-seven to seventy-three (2047). Many other observations have been made with a result always tending in the same direction.

That the alteration in age incidence is due to vaccination is stoutly maintained by the vaccinators, and traversed by the opposite section; some of whom nevertheless admit with A. R. Wallace that such a reduction has taken place which would take a long time to explain (7529). They appear to be divided in opinion between the possibility of a change of type in the disorder, its tendency as an exotic disease being to wear itself out, although in London in 1901-2 it did not show any signs of senile decay, or on the other hand that its diminution shows the beneficial effects of the improved hygienic and social conditions of these later years, although at Sheffield Barry says that the fatality was higher in the good class districts than in the poor.

Pressed hard, however, by the vaccinationists' figures, they are driven to other arguments. Cordwent,

for instance, in his evidence before the Commission states that as the system is incapable of receiving two diseases at the same time, vaccinia does confer a passing immunity against small-pox, but that this only lasts so long as the malaise accompanying the operation. Crookshank also admits a transient antagonism between vaccinia and small-pox.

The fact, however, remains that the death rate among the vaccinated is not so heavy as that among the unvaccinated. It has been urged that the weakly children have not undergone the operation on account of ill-health, this same ill-health rendering them liable to fall a prey to any form of infectious disease, and that the migratory and poverty-stricken class are at once more likely to be unvaccinated, and more liable to small-pox on account of their habits and social condition. From personal knowledge I should say that removals which allow parents to escape the attentions of the Vaccination Officer are much more the cause of non-vaccination than ill-health. In a certain district of Camberwell during 1903 when the registered births amounted to 4,393, the Vaccination Officer reports that there were 1,019 removals of persons liable to be compelled to have their children vaccinated.

Wheeler, however, admits that out of the 591 deaths in Sheffield there was opposition on the part of the friends or relatives in fifty-eight instances (V.C. vi. p. 614), and 'an objection' in forty-one.

The excuse of ill-health acting both as a post-

ponement of vaccination and as a predisposing cause of small-pox does not hold good in Leicester, where the larger proportion of children are unvaccinated. In 1892, 107 out of 347 cases were those of unvaccinated children.

Wheler points out that during the Sheffield epidemic the upper classes showed a great exemption from attacks of small-pox, a statement in which Barry agrees, and adds that in those better parts of the city about one half of the inhabitants were re-vaccinated (V.C. 28,825).

While there are numberless epidemics in which the protective power of vaccination has been shown, and of which I shall give examples, the recent one in London may be said to bear the palm for the complete carrying out of the subsidiary preventive measures, isolation, the following up of contacts; &c., and those who allege the favouring effect of insanitary conditions in the spread of the disease will readily admit that the sanitary condition of London is better now than it ever was. The unvaccinated section of the community therefore had the full advantage of all the preventive measures recommended by the anti-vaccinators.

In Sheffield there were 290 postmen and boys who had all been re-vaccinated, not one took the disease; 161 persons were in contact with the patients in the hospitals; of these eighteen had had small-pox, and two had been re-vaccinated subsequently, sixty-two had only been vaccinated in infancy, and six of these

had small-pox, while of the eighty-one who had been re-vaccinated, not one took the disease.

Five out of six officers who had refused re-vaccination at Leicester small-pox hospital were attacked, while of the remaining twenty-two who were either protected by previous small-pox or re-vaccination, not one took the disease. Twelve others who joined afterwards had all been re-vaccinated, and not one was attacked (Priestley, *Public Health*, vi. 315).

Thorne (V.C. 764) quotes an interesting contrast in the spread of typhus fever and small-pox from Gateshead. In the case of the pavilion for the former disease there were fourteen nurses employed, of whom nine contracted the fever. In the adjacent building for the isolation of the latter there were nine nurses, eight of whom were re-vaccinated, and one had had small-pox, not one fell a victim to it.

Beveridge, M.O.H., Leith (*Lancet*, 1894, ii. 1050), reports that there were about fifty servants, none of whom had previously suffered from small-pox; all were successfully re-vaccinated, and no one contracted the disease. At Hinckley in the same year there were fifteen all vaccinated recently, on taking up their duties, and all escaped.

Harris states (*Public Health*, vi. 384) that all the staff at the Southampton hospital were re-vaccinated before commencing duty; not one took the disease.

A Committee of the Epidemiological Society reported (*Ep. Soc. Trans.*, v) as a result of an enquiry into the staffs of the various small-pox hospitals that

of 79 persons who had had small-pox before service, not one took small-pox :

of 645 vaccinated in infancy and re-vaccinated on taking service, not one had small-pox :

of 10 vaccinated in infancy, but not re-vaccinated, all contracted small-pox at some time or other during their service.

This committee only found about sixty-nine cases out of the total admissions who had been re-vaccinated and had had small-pox, a number about equal to those who had had more than one attack of small-pox. 620 attendants are mentioned by Gayton, all of whom had been re-vaccinated except three who were the only ones to take small-pox.

At Liverpool, where all the Staff are re-vaccinated when entering their duties, no official contracted small-pox in the epidemic of 1903.

Dr. Ricketts reports to the Metropolitan Asylums Board in 1901 that two members of the staff had contracted scarlet fever, which is a rare disease in adults, whereas so far as small-pox is concerned no one who had been re-vaccinated contracted the disease, although as statistics prove, it is a common disease in those who are grown up. A man who was not protected in this way was attacked, although his duties consisted only in delivering meat at the hospital.

An instructive example of the value of vaccination is given by Dr. McCleary in his report for Battersea in 1902. He states that twenty-seven men were employed, two of whom had had small-pox, and of the

remaining twenty-five, fourteen had been recently re-vaccinated, and eleven had not, although vaccinated in infancy. Of these eleven, five contracted small-pox, but no other members of the staff were attacked. Hutton (*Vaccination Question*, p. 117) asks whether any doctor would allow his own vaccinated child to sleep in the same bed as a small-pox patient, this question is answered by Millard (*Small-pox in Leicester*, 1903), who, referring to this idea that a small-pox hospital staff in some way differs from the rest of the world, relates an experiment whereby he showed that it was possible for outsiders to run the same risk unscathed provided they had been recently vaccinated. Bradford in 1894 had (*B. M. J.*, 1894, i. 1101) thirty-six nurses in the small-pox hospital; of these, three had had small-pox, thirty-three were re-vaccinated and not one took small-pox.

Scott Tebb endeavours to belittle this immunity by pointing out the freedom of the nurses in the hospitals in the East during the epidemics of bubonic plague, and considers that the fact of their being nurses has a great deal more to do with their escape than the fact of their being vaccinated. This argument does not explain the fact that when a small-pox attendant is attacked he is found by a strange and frequent 'coincidence' to have been not successfully re-vaccinated, and that the re-vaccinated section escape small-pox although they fall victims to scarlet fever.

Colin is often quoted as giving evidence against the

protection afforded to those in small-pox hospitals by vaccination. It is true that he states (La Variole) that the greater number of the doctors and nuns who attended the sick had not been re-vaccinated and yet they escaped, while out of 200 others, the greater number of whom had been re-vaccinated under his own eyes, only fifteen were attacked; but he does not give any definite statement as regards the condition of each of the sufferers as to vaccination.

His general advocacy of vaccination is so strong, that it would seem probable that there were some circumstances which weaken this statement which is really in favour of the inutility of vaccination.

Campbell (*Public Health*, ix) states at Gloucester that none of the district nurses or those employed at the hospital contracted small-pox, they having all been successfully vaccinated, while of those employed by a hydropathist all were attacked except a vaccinated nurse who had been discharged from a fever hospital.

Porter (V.C. 22,211) states that at an Irish small-pox hospital were twenty-nine nurses not vaccinated. They escaped, as well as seven who had been. Under cross-examination he admits that his examination as to the vaccinated condition was only made in a 'general way,' and that he was guided by what he could see on the arms and face of some of them. During the examination of this witness a letter was read stating that Porter had not mentioned

that the twenty-nine nurses had probably had small-pox as they were not vaccinated.

Three vaccinated persons (*B.M.J.*, 1904, i. 210) connected with the Glasgow fever hospital had been re-vaccinated, and at the end of eight days in two of these the operation was repeated, on account of the failure of the first. This time it was successful, but too late, for small-pox developed within a few days. The third was put down for a second re-vaccination on account of the ill-success of the first, but for some reason it was never done, and she subsequently sickened with small-pox.

A case which had been mentioned by Wheeler is that of a nurse in Sheffield who was re-vaccinated unsuccessfully fourteen days before the eruption of small-pox, with a successful re-vaccination afterwards, but where small-pox developed before the vaccine vesicles.

Brailey, quoted by Cory (*Epid. Soc. Trans.*, vii. 217), says that out of 763 persons coming under his observation who had lost an eye, sixteen had suffered this misfortune as the result of small-pox.

Out of these sixteen, seven admittedly had never been vaccinated; two presented no marks, while five of the remaining eight presented marks which would not fulfil the requirements of the Local Government Board, one person being imperfectly observed.

It therefore comes to this, that while the proportion of unvaccinated in the normal population, giving the greatest latitude to the anti-vaccinators,

is about twenty per cent., the proportion of non-vaccinated persons, among these sixteen persons who have lost their sight from small-pox, works out at forty-three per cent., that is, double the proportion that the unvaccinated bear to the vaccinated among the general population. Of 147 persons who were scarred, fifty-six per cent. were admittedly unvaccinated.

Coincidence can hardly explain that the unvaccinated here suffer to nearly three times the extent to which they exist in the ordinary population. Iddesley (*Lancet*, 1894, ii. 1296), in describing an epidemic at Willenhall, where there were 261 patients, says that all those who suffered from the confluent form were unvaccinated.

An argument of a more general character is the marked decrease of pitting to be observed as one goes through the streets. Cory (*Ep. Soc. Trans.*, vii), after making observations in London, counted only nine persons out of 3,720 who were scarred by this disease.

Another effect of vaccination may be mentioned, namely, that of shortening the stay in hospital, and it is of special interest to note how this works out in towns such as Keighley, Leicester, and others, where the opponents are in strong force, and where the neglect prevails among all classes, and the unvaccinated cannot in any way be said to exist chiefly among the poor and ill-housed.

In Keighley, for instance, the average duration of

the stay in hospital was thirty-six days among the vaccinated, and fifty-three among the unvaccinated (*B. M. J.*, 1894, i. 1210). Of the persons who were removed from Greenwich during the 1901-2 epidemic those in the first category had an average stay of twenty-eight days, while for the second it was fifty-one days (*Report of Medical Officer of Health*, 1901). Priestley (*Public Health*, 1894, p. 315) says that the vaccinated over ten years had an average stay of 28.6 days compared with the non-vaccinated of 44.2 days, while of those under ten the latter class had an average of over thirty days more than the vaccinated children, and to the extent of 64.7 per cent. suffered from complications.

In Salford 132 cases were vaccinated (seventy-six per cent.), and of these thirty-nine per cent. had the severe form, and, as might be expected, the severer cases were almost entirely (ninety-eight per cent.) of those who were over ten years.

Contrast this with the unvaccinated, who were thirty-five in number; eighty-five per cent. had the severe form, 40 per cent. being those over ten years.

(Figures:—Total cases, 173: 132 vaccinated, fifty-two severe cases, and of these fifty-two, fifty-one were over ten. Not vaccinated class, thirty-five not vaccinated; thirty severe cases; fourteen were over ten. Six doubtful cases.)

Even when the influence of vaccination has so far waned as to permit a person to contract the disease, it is still able to ward off a fatal termination.

Pfieffer quotes the figures at Chemnitz, a town of 64,000 inhabitants, where the mortality is stated to have been two per cent. in the vaccinated, and ninety-seven per cent. in those unprotected, and we have Mr. Hutton's opinion (*Vaccination Question*, p. 64) that German statistics are usually more straightforward than the English ones.

Priestley (*B. M. J.*, May 5, 1894) mentions that out of the 107 cases under ten, two were vaccinated and 105 unvaccinated, the case mortality among the former being 0.0 per cent., while in the latter it was 14.3 per cent. In the Sheffield epidemic the case mortality per cent. for those over ten was 5.0 in the vaccinated and 30.4 in the unvaccinated.

The recent experience of Liverpool is instructive.

Among those who presented no marks at the Fazakerley Hospital, the mortality, taking all ages, was 23.4 per cent.; this includes the sub-division of those without marks, but said to have been vaccinated successfully or unsuccessfully, and whose mortality rate was 3.8 per cent. In those who presented marks the mortality at all ages is 2.6.

At the Parkhill Hospital the mortality of the first class is 23.4 (the sub-division above-mentioned showing a rise from 3.8 to 31.5 per cent.), while that of the second is 3.3, or including two severe cases where it was impossible to see the marks, 3.4.

The total numbers dealt with at the two hospitals were 716 and 1,344.

This report deserves special attention from the

fact that it sets out two cases in which there was a doubt as to the vaccinated condition on account presumably of severity of attack. This class, according to the anti-vaccinators, swells the total of unvaccinated deaths, because they say the marks very likely exist, but are obscured by the thickness of the rash, although Gayton states (V.C. 1822) that difficulty arises after the third day of the rash, and the usual but not universal practice is to remove (at all events in London) to hospital before this time.

A similar division is made in the Metropolitan Asylums Board report for 1901, where they include among those where evidence of vaccination is inconclusive those where the abundance of the eruption prevented any observation of the marks, if any existed, and twenty-three cases of this sort are recorded; the frequency of such a condition seems therefore insufficient to warrant the theory that it exaggerates the number of deaths among those said to be unvaccinated.

In response to an appeal in the Press, &c., as regards cases of small-pox which were said to have occurred after re-vaccination, Barry, on enquiry, ascertains that

Out of a received total of 352, 329 could be traced.
Nine had never been vaccinated.

Four had been vaccinated without success.

Thirty were vaccinated in the incubation stage only.
Ninety were vaccinated in infancy alone.

Forty-eight were re-vaccinated unsuccessfully.

Seventy were re-vaccinated during incubation.

Sixteen were re-vaccinated after recovery from small-pox.

Twenty-six who had been successfully re-vaccinated (? date) contracted the disease, and one of these was a fatal case (V.C. 28,532).

Thirty-six were found not to have had small-pox.

On account of the disorganization of trade and loss which to common knowledge is caused by an outbreak of small-pox, the subject of prevention should also be considered from the purely commercial aspect. The expense of the provision of isolation arrangements for this disease has been discussed elsewhere, but I did not then quote the experience of Berlin, where twelve beds *set apart in the other isolation hospitals* have been found sufficient for a population of over 2,000,000, while for London Collie thinks one bed per 1000 would be sufficient (*S. P. Hosp. Com.*, 2128).

A small number of adults will be found to take small-pox after vaccination and re-vaccination, just as there are second and even third attacks of the disease itself, and for these and for the conscientious objector isolation will have to be provided, let us hope for the latter at his own expense. But the elaborate system at present in vogue for securing the remoteness and sufficiency of these hospitals will be rendered nugatory, for if the main of the population be protected it will be of no importance to the

neighbours whether the hospital be in a crowded neighbourhood or in the wilds of the country.

As pointed out previously a vaccinated person may be more of a danger to the community at large under the existing conditions of primary compulsory vaccination than one unvaccinated, owing to the modifying effect which renders the malady less easy of detection, a fact emphasized by Millard, and one which no doubt explains the success of Leicester in warding off an epidemic through its system of isolation, &c.

It may be granted that so far as incidence is concerned, that infantile vaccination, while exerting a great influence on the mortality from the disease, has contributed, owing to its modifying effect, to its spread through its responsibility for the unrecognized cases. Choice then of further prophylaxis seems to lie on the one hand between the abolition of vaccination, which would render the cases of small-pox easily recognizable but severe, with the accompaniment of an increased mortality, and compulsory re-vaccination. Allowing with Millard that vaccinated persons, when the protective effect has waned but not disappeared, are more likely to spread the disease through their not being sufficiently ill to lie up, it is admitted that it is necessary to have protected persons to form the staff of a small-pox hospital. Even Crookshank admits this, although he would secure immunity for such persons not by vaccination, but by inoculation. Furthermore, those friends and doctors who have

been in contact with a case ought to be protected by the operation if it could be performed early enough after infection. Under these circumstances, after an epidemic there must be a large number of persons who will have been vaccinated even in unvaccinated Leicester, where there were 887 so treated. These then at some future time may have the disease in the modified form so dangerous to the public health; hence it will be necessary for them to be re-vaccinated after ten years if they are not to act as future disseminators of the disease. The re-vaccinated, although not a large section of the population, enjoy a practically complete immunity from the disease. It may be urged that the persons in this class are so few that the odds are, taking the ordinary theory of chance, against them taking the disease. In other words small-pox, attacking as it does a small percentage of persons, it is unlikely that any of the small percentage of re-vaccinated persons should happen to be among the former category. This class, it is claimed, escapes small-pox because it is small, and not on account of its re-vaccinated condition.

Chalmers, in his Glasgow report, gives a tabular statement in which he gives the number of cases registered during fortnightly periods, together with the population and number of persons successfully re-vaccinated. During the period at which the epidemic lasted, with its various periods of intensity, that is from January, 1901, to May, 1902, there were no cases among those who had been re-vaccinated

during this period. In answer to the contention that the number of such persons was small, it can be urged that out of a total population of 675,000 by April 6, 1901, over 200,000 had been recently re-vaccinated. Carmichael corroborates this in his report on re-vaccination, stating that no recently re-vaccinated person had contracted small-pox.

The escape of those who have been in close contact with those affected, such as nurses and disinfectors, who have been protected by re-vaccination has been mentioned, together with the frequency of attack of those who have not been wise enough to submit themselves to the operation.

Although the number of persons so employed who have been careless in this respect is small, if the number of persons attacked on the one hand among the re-vaccinated who form the majority of the attendants, and on the other among those only vaccinated in infancy or unvaccinated were equal, the proportionate liability of the latter to attack is greater, there being fewer persons to come in that category. It is found that practically the entire incidence in this class of persons is on those unvaccinated and those who have only been vaccinated in infancy.

During the eight years ending 1901 (Bruce Low, *Report to Local Government Board*, March 10, 1904), there had only been eight cases of recognized small-pox in Leipzig, a town of nearly 500,000 inhabitants, notwithstanding that it is a town somewhat exceptionally exposed to the danger of importation of

disease from neighbouring countries. In Würtemberg the isolation for small-pox to my mind is most insufficient, if it alone is to be relied on as a preventive agent, yet in eighteen years there have only been five deaths from small-pox in a population of 2,183,000. Instances might be multiplied almost to infinity, but the subject should not be dismissed without pointing out that Germany, with a population of (1900) 56,347,178, had 607 deaths in the twelve years 1891-1902, while in England and Wales, with a population of (1901) 32,526,075, there were 6,761 fatal attacks of this disease.

It has been urged that the great fall that has taken place in Germany since the introduction of the law of compulsory vaccination has been due to the improvement in its general hygienic conditions. If so, it is somewhat a rebuff to our boasted position of always being in the front of sanitation, for they are freer from small-pox than we are. From personal experience by nose and eyes it would seem that there is great room for improvement in that country in this respect, and there is in addition the history of towns like Hamburg which have recently suffered severely from epidemics due to insanitary conditions and yet have not been visited by small-pox to anything like the same extent as many of our English towns, such as Leicester, who pride themselves on their sanitary progress.

Peiper (*Wiener Klinik* 14 p. 198) speaks of the enormous fall in the mortality from small-pox in

the German army since 1870-71 when re-vaccination became compulsory in the German army, compared with the small decrease among the Austrians. This diminution is ascribed by the anti-vaccinators as being due to the progress in the sanitary condition of the former nation.

The difference is fairly considerable in the civil population.

Mortality per 100,000 of population since establishment of compulsory vaccination, (Edwardes, *Ep. Soc.*, v):

Prussian.

(Years) 1873-4, 35 and 9.

1875-81, 3.6, 3.1, .3, .7, 1.2, 2.9, 3.6.

Austrian.

(Years) 1873-4, 323, 178.

1875-81, 57, 39, 53, 60, 50, 64, 82.

In England, by one of the curious anomalies of which this country seems to be the home, the sanitary authorities are charged with the carrying out of all preventive measures against the disease with the exception of the measure *par excellence* most calculated to be of effect. Although medical officers have protested and urged that either the Borough or County Councils should be the authorities for the carrying out of this Act, the public vaccinators and the vaccination officers are still appointed by and are under the control of the Board of Guardians; and in London the duties of the provision of the means of isolation rests with the Metropolitan

Asylums Board, who are the representatives not of the Sanitary Authority but of the Guardians.

Free vaccination is at present carried out by the Public Vaccinators, and by them only. In non-epidemic times this procedure has perhaps no glaring defects, but in times of prevalence of small-pox it is altogether inadequate to the needs of the situation. As that functionary has to be communicated with it must involve the delay of at least one day, which may just make the difference between catching the disease or no, as well as the greater difficulty experienced in getting the people to submit to the operation, for when the shock of the presence of small-pox is fresh in their minds they are often more willing to be vaccinated or re-vaccinated than when they have had time to consider and gossip over the situation with their neighbours. Murphy, in 1881 (3031), has noticed the same willingness on the outbreak of small-pox; Stevens (3405) states that re-vaccination is neglected till small-pox is at people's doors, and Buchanan, at Purfleet, seems to have come to the same conclusion. Again, although not objecting to vaccination, they are often unwilling to pay their own medical man for the operation, and as they do not care to accept the gratuitous services of the Public Vaccinator, they let the whole thing slide. All this could be avoided by a simple order of the Local Government Board authorizing the various sanitary authorities in times of epidemic to pay practitioners, who have vaccinated persons in houses

attacked by small-pox, instead of as at present compelling the people to go to the Public Vaccinator. The Local Government Board, however, in 1902, on the application of the Borough Council of Camberwell, refused this very obvious and salutary course, and would only grant their sanction to vaccination by the Medical Officer of Health.

Taking a wider view of the subject, it seems a disadvantage to have one arrangement for epidemic periods and one for ordinary times, and the question arises as to whether the present system of state vaccination is not capable of improvement.

Indeed, the sanitary authority, who should also be the registration authority, should have power to pay for the successful vaccination of any child within their district on the receipt of a certificate stating the number of vesicles obtained, payments under this head being afterwards remitted to them by the County Council. The only duty incumbent on the operator if he send in an account to the Local Authority, being an obligation to use the certificate of the Sanitary Authority and to keep a register of all such cases which shall be open to the vaccination inspector, who may be either the Medical Officer of Health or preferably a person specially appointed. There is nothing new about this recommendation, for it appears in the Report of the Commission, where as a safeguard to secure the efficiency of the practice, they recommend that payments should be made when the certificate showed that the operation had been performed in

accordance with orders to be made by the Local Government Board.

As is well known, the Local Government Board have issued regulations on the number of punctures, the precautions necessary, &c. These, however, only apply to the Public Vaccinators, between whom and the private practitioners an unholy competition exists in poorer neighbourhoods, where we find that two different courses are pursued. Some practitioners make an appeal for custom, and this word is used advisedly, on the ground that they only give one mark, while others take the strictly commercial but more honourable view that for sixpence they give one mark, charging an extra sum for each one beyond this (Brierly, *Lancet*, Aug. 12, 1899). Facts such as these, whilst exciting regret that they should be used by the profession, cannot but impress on all interested the necessity for an authoritative statement by the Local Government Board as to the minimum on which a certificate of successful vaccination can be based.

Their recommendation could then be incorporated in an Act in which a penalty can be imposed for giving a certificate for successful vaccination unless these requirements have been carried out.

Lymph from the Government Laboratories is supplied only to the Public Vaccinators, other practitioners, in spite of their protests, being compelled to obtain their supplies from private sources. These, however excellent, can never take the position that can be claimed by the Government institution, and

considering the importance of the subject to the state, it does not seem reasonable to deny the great body of medical men the advantage, and to hold it out to the Public Vaccinators alone.

Supposing, however, that the abolition of the Public Vaccinator be not carried out, improvements may be made in the present procedure. A crying need is a reform in the system by which public vaccinators are only paid for the vaccination of those who live in their district. During the last epidemic it frequently happened that they were asked to vaccinate the employés at large institutions and places of business. When, however, the time came for payment, although they had carried out the work, the names of all those without their own districts were cut out of the bill, thus entailing a loss on the vaccinator. Now the greater number of persons who were re-vaccinated in this way were of the lukewarm class, not violently opposed to vaccination, but who would hardly take the trouble to cross the street to submit to the operation, a class forming the great bulk of the population, and it is certain that had not the facilities for being re-vaccinated been offered them at their place of employment they would never have sought others.

The question which next presents itself is as to when re-vaccination should be performed. The Local Government Board, by only sanctioning payment after ten years of age, would appear to hold that up to that age the protection afforded by primary vaccination is sufficient. As a result of his Sheffield

observations, Barry would appear to agree with this. The Society of Medical Officers of Health recommended (*Public Health*, ix) that re-vaccination should be obligatory at the age of fourteen years. According to Edwards, the German Small-pox Commission in 1884 recommended re-vaccination ten years after the primary operation.

It is, however, reasonable to suppose that there are some people who are more likely to encounter the infection than others, and who therefore should be specially considered. Among these are the staffs of small-pox hospitals, who, according to Birdwood (31,291), should be re-vaccinated every two years, while a French writer (*Gaz. Hebd.*, p. 74, 1902) would have laundresses done every five years. In Germany, where re-vaccination is the rule, those who come in contact with the sick are again re-vaccinated on their taking up duty.

Speaking generally, the London epidemic would confirm the view of the Local Government Board, for it was much rarer to find attacks among vaccinated children in the age period, five to ten, than it was ten to fifteen. According to the Metropolitan Asylums Board Report for the year 1901-2, the number of vaccinated and doubtfully vaccinated children for the first age period was 142, and 363 for the second, while for the unvaccinated class they were 563 and 386 respectively.

While in theory it is a perfectly sound principle to compel people to submit to regulations designed for

the general welfare of the population at large, unless overwhelming public opinion be on the side of compulsion in practice, it is better to secure compliance by placing restrictive conditions and limitations on those who do not carry out the law. Mrs. Garrett Anderson (*Vaccination and the Rates*) makes a suggestion that all employers should make it a condition of employment that re-vaccination has been carried out. It would, no doubt, be better to have a similar clause as that which exists in regard to primary vaccination, by which a parent can get relief if he has a conscientious objection and is prepared to make application to the magistrate for exemption. The indifferent, who after all form the great bulk of the population, will have to take some decided steps in the matter, and the option given will do away with the chance of the anti-vaccinator posing as a martyr when he is fined or imprisoned.

The conscientious objector should be made to pay for his own and his family's keep in hospital should any of them be attacked by small-pox; so too should any one else who is not able to produce a certificate of successful vaccination or re-vaccination, according to the age of the person attacked.

Dukes, in a letter to the *Lancet* (i. 131, 1903), appears to favour the opposite view, and would be inclined, instead of making things irksome for the anti-vaccinator, rather to make them pleasant for its supporters; perhaps a judicious combination of the two methods would have the desired effect.

As a development of the theory of passive resistance it might be held to be unfair that the conscientious objector should have to pay for vaccination in general ; but if this were allowed it is to be feared that the number of such worthies would assume enormous proportions.

The favourite argument of the anti-vaccinators is something like this. Taking, for example, the epidemic of 1901-2, in London there were 9,659 admissions to hospital; of these 7,381 were vaccinated, or doubtfully vaccinated, and only 2,278 were unvaccinated, while of the deaths 876 were vaccinated and 753 were not. How then can it be stated that vaccination is a remedy? Or they may take the figures referred to in the Vaccination Commission (Q. 288), where there were 53,000 cases, of which 41,061 were vaccinated.

On examining the London figures we find that 1,441 of those admitted were under ten, while 8,218 exceeded this age. Of the former 167¹ were vaccinated, and 1,274 were unvaccinated. Absence of vaccination among school children in Wandsworth was found to the average extent of 20 per cent., which may reasonably be taken as an index of London, so had this ratio existed in the children admitted there should have been about 288 unvaccinated to 1,153 vaccinated cases.

Again, among the vaccinated of those over ten the death rate was 12 per cent., while among the unvacci-

¹ Those about whose vaccination there is doubt are classed with the vaccinated.

nated it was 30 per cent., and of the 119 deaths of those under ten only eight took place among the vaccinated.

They are also fond of taking an epidemic in a town which they say is well vaccinated, such as Sheffield, and then showing the severity of the disease in the well-vaccinated town compared with Leicester, renowned as the stronghold of the anti-vaccinators. There can be no doubt, if the bare figures be looked at, the latter appears to fare better than its more protected neighbour, and a fallacious conclusion will be drawn; hence, to be of value, the statistics must be examined to ascertain the incidence on the vaccinated and unvaccinated at various ages, with the proportion of each class resident in the town, and thus to ascertain whether the attack rate in the unvaccinated and vaccinated respectively is approximately the same as the proportion of each class among the residents; if not, it is reasonable to infer that there is something in the operation which disturbs this relation, an inference gaining strength if a similar event has been noticed in many instances.

It was in view of the necessity for proving the great preponderance of the vaccinated in Sheffield that Dr. Barry took his census. The fact that the incidence of the disease in the vaccinated and unvaccinated might not be proportionate to the numbers resident in the town, brought about a pause in the attempt to prove that Sheffield was a well-vaccinated place. In spite of the statement of Professor Crookshank,

an anti-vaccinationist, who says (*Lancet*, Nov. 24, 1894) it was calculated that 98 per cent. of Sheffield were vaccinated, Mr. Wheeler tried to make out that 14 per cent. of Sheffield was unvaccinated (V.C. 19,494), by asserting the absence of any proof that the amount of vaccination had increased since 1862, when 86 per cent. of school children were found to be vaccinated, he further states that the census was taken so late in the epidemic that a greater number of persons appeared as vaccinated than usual, although Barry (V.C. 24,428) states that even in 1886 only 3.4 per cent. of births in the Sheffield Union, and 4.0 per cent. in the Ecclesall Bierlow, were unaccounted for, the number of primary vaccinations being 85.6 per cent. of the number of births. Wheeler goes on to say that when interrogated by the census officials people objected to be questioned or gave wrong answers, so as to avoid the chance of being prosecuted, so that apparently the refusals should mean absence of vaccination. This may have been the case in Sheffield, but in Camberwell there is no hesitation among the inhabitants to express their opinion if they are of that way of thinking, for they would appear rather to glory in it than to attempt any concealment. The necessity for making the proportion of the unvaccinated as large as possible has not escaped other members of the anti-vaccinationist camp. Picton and Collins endeavour to show that in 1892 the defaults in respect to births had increased to 18.4 per cent. Wallace, on the other hand (V.C. 7096), states that if not now it soon must be

that ninety-five per cent. of Londoners are vaccinated, although later on, when confronted with the decrease in the mortality concurrently with the increase of vaccination, he opines that owing to opposition vaccination has recently decreased.

The anti-vaccinators rely on the stamping out system, which may be summarized as—

- (a) Early diagnosis with prompt notification.
- (b) Prompt isolation free of cost in a suitable hospital for all cases.
- (c) Disinfection and observation of contents, together with improved sanitary law and administration.

Leicester is often quoted by the anti-vaccinationist party as an example of the superior efficacy of such preventive measures as notification, for which, in 1879, the authorities had obtained power to insist on, and at the same time, or rather earlier (V.C. 13,153), they started a system of isolation, which consists in all inmates and contacts being removed to a ward in another part of the hospital for fourteen days (V.C.13,152); not all submit to such a treatment, where they are practically under surveillance. Quarantine, where persons are 'persuaded' to go (16,436), is carried out in a block (sometimes two), situated in hospital. Thorne-Thorne, however, points out that in Leicester, in 1870, when there was no hospital and no isolation, the deaths from scarlet fever presented no great difference from 1879, when both these measures were in force.

The town is always held up, both by the advocates and opponents of vaccination, as one where the vaccination acts are but indifferently carried out. Biggs, for example, boasts (V.C., Apr. 29, 1891) that small-pox mortality in Leicester is extinct, and has been so since 1883; although, according to Crookshank (*Lancet*, Nov. 24, 1894), all attempts since 1886 at compulsory vaccination have been abandoned, the number of vaccinations in that year being 598 (V.C. 12,993), and 219 in 1888 (V.C. 13,039); hence there will be a large number of persons who are without any protection at all, and who, if they should contract the disease, will not be liable to escape observation on account of their having it in a mild form.

Mr. Hutton, writing in 1894, quotes Gloucester as being among those where there is a great and growing neglect of vaccination, and yet which had escaped. He should have delayed his comments, for in 1896 that city was visited by a great epidemic, while in Leicester there was a severe visitation in 1893, and in 1904 there were 368 cases notified, and twenty-one deaths. Evidently Mr. Biggs's boast that the disease was stamped out is a little premature.

There can be no doubt that if vaccination be done away with, all the other measures must be carried out with the utmost stringency, and their neglect made a criminal offence. In smaller places they may possibly be so insisted on, but when, as it did in Camberwell in 1901, the number of people who were under supervision in one week increases suddenly to over 2,000,

it becomes unnecessary to dilate on the impossibility of proper supervision, the paralysis of work, to say nothing of the heavy cost, that must ensue.

Davidson (V.C. 22,462), speaking of his experience at Congleton, speaks of the necessity of keeping inmates of an infected house in quarantine for a month if the sick person did not do as the majority did, and be removed to hospital.

The anti-vaccinators lay great stress on the necessity for rapid and early diagnosis, and it is well that they do so, for the whole of their system rests on it, and all the good they can do by their preventive means will be rendered nugatory by the non-detection of a mild case.

This early diagnosis is a very weak point in the case of those who rely solely on the so-called Leicester method, of which the report of Messrs. Picton and Collins is an amplification. It is not a rare event to find that a person supposed to be suffering from this disease is sent to the shelters. While there he must come in contact with the contagion of the disease. Theoretically, with almost superhuman regulations, superhumanly obeyed, it might be possible to devise a means by which the receiving room and its attendants might be kept free of all infection and consequent danger to a person who was not suffering from the disease. At present this danger is removed by the practice of the Metropolitan Asylums Board of vaccinating a person brought to the Wharf under such circumstances, but this would naturally be dispensed

with by the anti-vaccinationists. There are some instances also where an immediate diagnosis is not possible at the moment, and who have to be detained at the shelter for as much as three or four days. The danger of such persons in the midst of infection must be great if not protected, unless isolation be carried out with the absolute perfection that it is not given to man to attain. Reliance on isolation, &c., in place of vaccination is condemned as useless and impracticable by the German Small-pox Commission (Edwardes).

An unvaccinated town relying on such measures may stand a better chance as regards prevalence, but not as regards case mortality, than the partly vaccinated, for in this latter there is always the probability of the cases being modified and able to get about to spread the infection, while in the other the disease will be well marked and easy of diagnosis. This has been pointed out to have happened at Leicester in the last epidemic (Millard's Report).

In considering the alleged ill effects, it is well to bear in mind Hutton's warning (*Vaccination Question*, p. 6) of *post hoc ergo propter hoc*. Lankester, a witness before the Commission, whose evidence could be confirmed by every medical man in practice, states that bad eruptions have occurred in unvaccinated children which would certainly have been put down as being the effects of vaccination had that operation been performed (V.C. 13,047).

The practice of vaccination was asserted by Biggs to be a cause in the increase of mortality (V.C. 17,663),

and when cross-examined as to why there is no marked decline in mortality corresponding to the discontinuance of vaccination, puts it down to the artisans working in factories to a greater extent than formerly (V.C. 17,705).

Ogle states that the proportion of deaths in vaccination is 1-14,159. So far then as a fatal injury is concerned a child runs less risk of death from vaccination than it does from being suffocated by overlaying on the part of the parents, while the Report of the German Imperial Board of Health (*B. M. J.*, 1904, i. 903) says that among 166,619 children that were vaccinated, 115 deaths occurred within a few weeks or months of the operation, and were presumed to be due to it; on closer examination, however, the number materially lessened.

That the evidence of the parents as to alleged injury should always be read, if possible, with that of the doctor attending the case, is abundantly evident from the proceedings of the Commission. Mr. Biggs, one of the ablest of the anti-vaccinators, would, however, feel himself quite justified in ignoring a medical man's statement (15,255); yet he is ready to blame a public vaccinator for taking a parent's opinion as to fitness for vaccination (15,270), although in other instances he would prefer their views to those of a doctor.

He quotes a case (V.C. 15,373) of a child who died sixty-four days after vaccination, but whose death he admits, under cross-examination, to have been due to this cause only from his own version of the evidence

supplied to him, indeed, belief in the harmfulness of vaccination appears to rest on somewhat flimsy evidence (V.C. 13,724).

It is much more comforting and respectable for a parent to be able to point to vaccination as the cause of infantile syphilis than to be forced to admit that the disease in the particular instance was inherited.

Quite soon after the introduction of vaccination there were not wanting those who alleged injurious effects to follow the operation. Cline, for instance, says that vaccination was a cause of that vague condition *serofula*, and Rogers, in his *Examination of the Evidence on cow-pox* (1805), mentions a fatal case of small-pox after vaccination, and also asserts that the practice, while in no sense being any protection, has caused new diseases to appear. The anti-vaccinators of those days were usually strong upholders of the practice of inoculation, and could hardly be quoted by their successors of the present day.

Birch, who was surgeon to the Prince of Wales in 1808, and on the staff of St. Thomas's Hospital, in his *Serious Reasons for Objecting to Vaccination*, states that it has caused altogether novel kinds of eruptions to appear, and in no case can the operation be considered to afford any security against an attack of small-pox.

The diseases which are usually supposed to be caused by vaccination are:—Erysipelas, Syphilis, Tubercle, and various skin eruptions, which also are

supposed to become more intractable. But besides this there may be ill results from the non-healing of the punctures. Dakers, for example, records a child whose arm had not properly healed at the age of twelve years. Further, according to Biggs, it is a predisposing cause and an intensifying agent in the mortality of zymotic disease (V.C. 17,249), and a probable and predisposing part of some of the increase in the death-rate (V.C. 17,336).

Among the rarer sequelae must be mentioned leprosy. Brunt mentions the case of a woman (V.C. 20,204) in which this developed some months after vaccination at the scar, and extended to other parts of the body. But as leprosy was present in the district referred to at the time, this case may be very properly commended to the *post hoc propter hoc* section, indeed, owing to the protracted and uncertain length of the incubation stage of this disease, conclusions are difficult to draw. It has also been credited with the increase of cancer, but as Edwards remarks, this increase has been among males, yet vaccination is performed on both sexes alike.

Even small-pox itself has been pointed out as a result of vaccination, for Wallace admits that the statistics he gives, if logically pushed, would prove that vaccination creates small-pox if there were no other agent at work (V.C. 7165). Biggs also states as an incontrovertible fact that increased vaccination was followed by an increased amount of small-pox.

Among the rarer diseases ascribed to this source may be mentioned glandular enlargements, anaemia (V.C. 21,610), while that vague condition, marasmus, is said to be more likely to be fatal after vaccination (V.C. 21,772).

Erysipelas is one of the most frequently used arguments, and Biggs, in his examination before the Commission, quotes three deaths in unvaccinated and four in vaccinated children. When pressed, however (V.C. 14,773), whether, as seventy-nine per cent. of the children are vaccinated and twenty-one per cent. not, the rate of deaths was larger in the unvaccinated, his answer is that to his mind the question is whether the four would have died had they been unvaccinated! After vaccination, and indeed after any wound, there is always the danger of this disease; but it is a danger which can be minimized by the precautions of the doctor performing the operation, and by the subsequent care and attention of the parents.

That syphilis can be transmitted in the operation of arm-to-arm vaccination must be accepted as proved. Compared with the number of vaccinations the number was small, but its possibility no doubt largely influenced the Commission in making their recommendation for the official use of calf-lymph. Lee, for instance (V.C. 30,414), states that out of 600 cases of infantile syphilis he thought that there was one undoubted case; but under a somewhat searching cross-examination it does not seem truly a case of inoculated syphilis. The Commission also had under

its notice a report by Ward of a child which was supposed by the whole of the surgical staff at the Leeds Infirmary to be suffering from vaccine syphilis, but which was not altogether subsequently accepted as proved by the Commission.

Rauch (V.C.), for instance, speaks of 88,000 cases having been vaccinated, kept under observation for three weeks (the incubation period of syphilis), and at the end of that time presenting no sign of this disease.

Pernet (*Lancet*, 1903, i. 87), quotes Crocker's observation of 20,000 children in hospital practice without one case of vaccinal syphilis.

Brown, speaking of his observations at the Hackney Hospital, found that four per cent. (20,400) of children suffered from hereditary syphilis. Such an experience in the days of humanized lymph, when the opportunities for a hypothetical transmission of syphilis were existent in vaccination, proves that its inoculation must be rare. McVail (*Public Health*, ix. 201) also points out that in unvaccinated Leicester the mortality from syphilis for the past twenty years had increased by 69.3 per cent., as opposed to 24 per cent. in England and Wales, and that an increase had also occurred in the erysipelas mortality compared with a decrease elsewhere.

Now that the system of arm-to-arm vaccination has been replaced by glycerinated calf-lymph, the anti-vaccinators have been robbed of a great war-cry, and it is not surprising to find that it is the danger of tuberculous infection that is now paraded. Even

supposing the negative results of inoculation of an animal with tuberculous material be not taken into account, it is known that the infection of tubercle is arrested partially if not completely at the first gland above the point of entry, so that if infection after vaccination were common we should expect tubercle of the axillary glands to be a frequent occurrence, whereas the commoner glands to be attacked are those connected with the respiratory and alimentary passages, showing the ordinary source of infection to be in the air or in food.

‘That the statistics and statements of the vaccinator are unreliable and worthless’ (Swan, *Prize Essay*), is an argument fully bearing out the old proverb, ‘If you have a bad case, abuse the opposing attorney.’ In Sheffield the statement was made that the unvaccinated purposely did not receive such careful treatment in hospital as did the vaccinated (V.C. 20,675), although Barry found no prevalence of this idea.

Such arguments in the controversy are by no means of recent origin, for in 1800 Brown, a surgeon of Musselburgh, accused the vaccinists of explaining away attacks of small-pox subsequent to the operation by the evasive suggestion of flea-bites or chicken-pox as the correct diagnosis.

He even goes so far as to say that the vaccinators do not altogether believe in their own nostrum, for they advise their vaccinated children to keep away from those that are infected.

Wallace (V.C. 7060) would reject all medical or official statistics, apparently on the ground that the mortality in the last century was on the average eighteen per cent., when it was the rule for people to be unvaccinated, while the mortality at present shown in hospitals is thirty to sixty per cent. in the unvaccinated. He is, however, apparently oblivious of the fact that epidemics vary exceedingly as regards their fatality. Boobyer, for instance, states that the case-mortality in Nottingham in 1903 among the unvaccinated only amounted to 12.50; not only this, the London bills of mortality of the eighteenth century were defective and not implicitly to be relied upon. Whitelegge, also, in his evidence refers to the rise and fall of virulence, in small-pox as well as in measles (V.C. 29,720) and scarlet-fever; while Barry states that in 1804 the case-mortality was over 15.0 per cent.

It is known to all who are acquainted with the splendid work of Barry in the Sheffield epidemic that his figures were subjected to severe criticism, especially by Wheeler, who attempts to discredit all the conclusions arrived at by the former (V.C. 19,651, 28,664); and it will be interesting to note how far they bear out the sweeping assertion of the anti-vaccinators, that the statistics in favour of vaccination are unreliable, and also the former's statement that in any case of doubt he has always leaned to the side of the opponents rather than to the supporters.

For instance, Wheeler quotes as a 'typical unvac-

nated case,' a woman entered as not vaccinated because she was in such a bad state, whereas she should have appeared as a re-vaccinated person having small-pox. Barry, who saw the bed card and hospital register, states that not only was the woman entered as being vaccinated, but that the character of the marks was also stated (V.C. 20,007, 28,641).

Parton (20,489) was asked by an anti-vaccinator to examine the cases contained in Table XIV, which deals with attacks of the unvaccinated occurring in the Attercliffe district. They number twenty-nine, and Parton, who enquired into all he could, making no notes when the table was correct (20,515), discusses ten. In one he gives different information as regards previous health; and in another of these Barry got the information from the parents, whereas Parton did not; the cases not traced by the latter amounting to less than a third of the total number (20,540, 28,945).

Barry states that out of a total of 343 cases in the unvaccinated list Parton refers to seventy-six, or less than twenty-five per cent. Out of these Barry says that three cases would have been transferred to the vaccinated list had he obtained the same information; and he further quotes cases where he has included as vaccinated cases where there was the slightest evidence that vaccination had been performed (29,345, &c.). This did not seem as if the vaccination statistics were biased to the extent alleged.

It would be well also to consider whether the anti-vaccinationist is as strictly correct in his statements

as he should be, before adopting a Pharisaical attitude towards the upholders of the practice. Hutton (*Vaccination Question*, p. 73) says that the report of the Metropolitan Asylums Board for 1893 'admits that several cases of small-pox occurred among the staff in that year.' What is the inference desired to be drawn? Is it not that the Metropolitan Asylums Board are reluctantly compelled to confess that several of their nurses who had been vaccinated had yet been attacked by small-pox? The admission referred to is a straightforward report by Dr. Ricketts, giving particulars of six cases among the permanent staff. In one of these the disease developed three days after joining; three others were only re-vaccinated successfully seven days or less after joining; while two others had not been successfully re-vaccinated, although three attempts had been made.

A paper has been recently circulated in which a reward of £1,000 is offered to any one who proves the statements therein made to be false; it is asserted, for instance, that members of the royal family are not inoculated with vaccine lymph but with some matter which produces inflammation, and is called vaccination! It can be left to the judgment of any sensible person to decide between the risk of the two inoculations, but when they go further and say that doctors themselves are not vaccinated they say that which is not true. Such statements should not come from the party which condemns the other on the grounds of manipulating and garbling statistics.

It appears that the anti-vaccinator considers that the operation is unscientific because of the uncertainty of the nature of the lymph used, there being they say no connexion between small-pox and cow-pox. Hutton even goes so far as to say that the strength of the case against vaccination depends first on the absence of any relation between the two diseases. To adopt the words of the Royal Commission, the theory of differences between the diseases must be viewed with distrust, although there are not wanting even at the present day those who deny the connexion between them.

That a proved connexion would much strengthen the case for vaccination is obvious, but that its absence should correspondingly weaken it does not seem so clear. The important practical question is whether vaccination has influence over small-pox or not. In absence of direct experimental proof, which will only be obtained by studying the effects of inoculation of vaccinal and variolic lymph on a number of human beings, it is unlikely that the question will ever be absolutely decided either one way or the other, but by statistics the amount of probability in one direction can be sufficiently great to amount to a certainty. Crookshank (V.C. 12,366) admits that he knows of no proof that cow-pox is not derived from small-pox. In these days it is unlikely that any government will have the courage to give a criminal condemned to death the opportunity of commutation of his sentence into penal servitude if he submit to be inocu-

lated so as to prove the theory either one way or the other.

Many contend that bovines and equines are subject to an eruptive disease identical in nature with variola. Brouardel (*Twentieth Century Practice*) reports the Toulouse epidemic, where matter from a horse affected by a pustular eruptive disease was inoculated into a cow, producing cow-pox, and comes to the conclusion that horse-pox is a source of vaccinia. Some babies were inoculated with this cow-pox and with human vaccinia; identical results followed as regards the character of the eruption. Seventeen other young animals were inoculated with variolous matter, and it was subsequently found that when in fifteen out of the seventeen ten, were inoculated with cow-pox and five with humanized lymph, only one developed typical cow-pox.

Although he considers that the two maladies may be derived from each other, Chauveau (*Mercredi Med.*, Oct. 28, 1891) concludes as the result of his experiments that variolic virus introduced into bovines remains variolic virus, and when after several cultures it is again inoculated into man, it still retains its variolic properties, and shows no tendency to become vaccinal virus. Cordwent gives the result of vaccination of cows from human beings as an abrasion and not a vesicle.

So far back as 1874 Burdon-Sanderson drew attention to the analogy existing between sheep-pox and human small-pox, and foreshadowed the particular

nature of the small-pox virus, quoting Weigert and Cohm, the latter describing organisms in variola resembling those in vaccinia. Guanisi of Pisa (*Lancet*, i. 1894) describes an organism which he considers the cause of variola and vaccinia.

Copeman claims that his experiments prove that it is possible to variolate the calf, modification taking place in successive cultures, and the animals so treated becoming insusceptible to vaccination; he also (*Public Health*, viii. 274) describes a small spore-bearing bacillus of which he has found examples practically identical in vaccine and variolous lymph.

Seaton relates the instance of some young cows which had been seen in a field licking some bedding of a small-pox patient. Five out of eight developed cow-pox.

Another shibboleth is the statement that filthy matter is introduced into the blood by the operation. But before they talk so glibly about filth, let them read some of the reports on London milk, which, it appears, would compare badly with vaccine matter in respect to its freedom from dirt and bacteria.

I have even heard it stated derisively that vaccine is made from the grease in the horse, possibly by those who are under the impression that the grease is the fat derived from this quadruped, and by some process elaborated into vaccine lymph; while insinuations are made that the value of the operation is belauded and its necessity emphasized, simply on account of the money it brings to the vaccinators, although there can

be little doubt but that the profession at large would gain financially by small-pox being treated by isolation, &c., alone.

There is a further statement of the anti-vaccinators, for it can hardly be termed an argument, that vaccination is a grotesque superstition, the invention of a fallible profession, and the public are being deluded by a sort of vaccine confidence trick. If this be so, one can only marvel at the subtlety of the doctors who are able to make employers of labour compel their employees to 'barter their bodies' or accept dismissal, and to so far obsess the trained mind of the magistrate, who is supposed by Mr. Hutton to take a churchman's view of the enormity of the offence of non-vaccination, and to make him twist the intentions of Parliament into a further measure of persecution.

The employers, who are usually hard-headed business men, seem to know their mind on the subject, for at a deputation to Mr. Long there was presented a petition from employers of over 30,000 persons in favour of re-vaccination.

The cost of an epidemic in the way of loss of life and health and the dislocation of trade, although enormous, can never be ascertained; but it is possible to ascertain the amount which the unfortunate ratepayer has to contribute in order to find the money for our present expensive method of dealing with an outbreak. Scovell quotes a memorandum showing that up to 1893 the average cost of the Metropolitan Asylums Board Small-pox Hospitals was £49,000.

Sanders (*Public Health*, vii. 147) reports that the 1884-5 epidemic of small-pox (exclusive of capital charge) cost the ratepayers £275,135.

In Battersea, apart from chicken-pox notification fees, £148 17s., the actual expenses, apart from its contribution for 1901-2 to the £500,000 called for by the Metropolitan Asylums Board, amounted to over £1,150, and there is no reason to suppose that the other boroughs got off any better.

In addition to this the cost is £724,698 (Mrs. Garrett Anderson, *Vaccination and the Rates*) directly attributable to small-pox, and which will have to be paid by the long-suffering ratepayer. If he could think that such a sum would only be required of him in epidemic years he perhaps might be easier; but let him remember that a small-pox hospital must be always kept ready prepared and fully equipped with a sufficient staff to be of any use in 'stamping out' outbreaks of small-pox. For as Mrs. Garrett Anderson (*Vaccination and the Rates*) points out, it is impossible immediately to transfer nurses and officials from the scarlet-fever and diphtheria hospitals to those intended for the reception of small-pox. There is consequently a heavy annual charge to be met for upkeep, even putting aside the heavy initial cost of sums varying from £308-980 per bed (Garrett Anderson, Folkestone Congress of Public Health).

For a less sum than £500,000 it would have been possible to re-vaccinate all those in London over ten years of age in 1901, and we should have gained even

on diminution of taxation, leaving apart the amount of trouble and death that an epidemic must cause. And with our present system of vaccination there may very likely be another epidemic of small-pox within the next few years.

VAGRANCY

The difficult problem of how to deal with vagrants, and especially with the habitual variety, who, as we have abundant evidence, frequently spread disease, has recently received the attention of the various sanitary authorities who met in conference under the auspices of the London County Council. Considering the power these possess in the conveyance of small-pox, it does seem necessary that some control should be put on them so as to lessen their capacity for evil. At the conference the tramp was the great subject of discussion, and he was by some recommended for a compulsory and disinfecting bath. So far as small-pox is concerned, the only use might be that during or after the bath it might be possible to see the eruption. The proposal, as might be expected, brought forward the usual outcry of the resistance of the freeborn Englishman to compulsory measures. Why the feelings and rights of a gentleman who spends his days in neglecting his duties to the State should be treated with so much consideration I cannot say.

It was also proposed that weekly returns should be made by the Local Government Board, and by that body transmitted in turn to all these all over the country. Like many other well-meaning but ill-advised precautionary measures, this has a certain specious attractiveness which might lead to its adoption, thereby entailing labour and expense without any corresponding advantages; and another resolution favouring the establishment of bureaux was carried. To both of these proposals the objection must be urged of time. So far as the first is concerned there might quite easily be an interval of ten days between the outbreak of small-pox in a given locality and its being brought to the knowledge of the other authorities; and in the second the success, whatever may be said as to the possibility of sending out particulars for identification, &c., must depend largely on the veracity of the tramp.

Finally, the only effectual measure was adopted, i.e. the compulsory vaccination and re-vaccination where necessary was proposed of persons in casual wards and common lodging-houses who had been exposed to the infection of small-pox. If it be agreed that the risk of persons catching the disease is diminished by their being vaccinated, it seems difficult to resist the conclusion that the class who are so frequently instrumental in spreading the disease should be prevented from catching it. At present, for this most desirable consummation we are bound to rely on 'bribery, cajolery, and a little bluff'

(Barlow, *M. O. H.*, Bootle). It should be a duty imposed on the various sanitary authorities throughout the kingdom to order his vaccination or detain him for sixteen days, for by that time if he has contracted small-pox it will have manifested itself. If, however, he presents signs of recent successful vaccination, he may be dispensed from compliance with this order on the certificate of a District or Workhouse Medical Officer. The difficulty will, however, certainly arise in consequence of the non-observance of the regulations by some authorities, who, mistaking licence for liberty, will hesitate to exercise compulsion. Provision must therefore be made for the intervention of the County Council or the Local Government Board in case of defaulters.

1951-1

Peace Colln.

